Chapter 6
Surface Water

6.1 Environmental Setting/Affected Environment

California is characterized by 10 hydrologic basins, as shown in Figure 6 1. As described in Chapter 5, surface water that flows through the Delta and is conveyed by the State Water Project (SWP) and Central Valley Project (CVP) facilities primarily occurs in the Sacramento River and San Joaquin River hydrologic basins. A portion of the water from the Trinity River watershed in the North Coast hydrologic basin is conveyed by the CVP into the Sacramento River basin, as described in Chapter 5. Some of the SWP and CVP water supplies are conveyed in rivers and streams within Sacramento River and San Joaquin River basins, and thereby, affect surface water flows in those basins. In San Francisco Bay, Central Coast, South Coast, Tulare Lake, South Lahontan, and Colorado River hydrologic basins, SWP and CVP water supplies are conveyed in pipelines and canals and do not directly affect surface waters.

For the purposes of this analysis, the surface water study area specifically consists of the North Coast, Sacramento River and San Joaquin River basins, including the Delta and Suisun Marsh located at the confluence of the Sacramento and San Joaquin rivers. These surface waters represent the geographic areas where potential changes could occur to surface waters due to modifications in SWP and CVP water supply operations and implementation of habitat restoration in the Delta and Suisun Marsh in Restoration Opportunity Areas (ROAs) identified in the Bay Delta Conservation Plan alternatives.

Many topics related to surface water resources in the Sacramento River and San Joaquin River basins are also discussed in other chapters. Chapter 5, Water Supply, describes the overall surface water and groundwater supplies in California that are directly or indirectly affected by SWP and CVP water supply operations and implementation of habitat restoration in the ROAs. Chapter 8, Water Quality, describes surface water quality in Sacramento River and San Joaquin River basins. Chapter 7, Groundwater, describes groundwater characteristics in the Sacramento River and San Joaquin River basins that are directly or indirectly affected by changes in surface water characteristics.

6.1.1 Potential Environmental Effects Area

The Sacramento River is the largest river in California and is bounded by the Cascade and Trinity mountains on the north, the Delta on the south, the Sierra Nevada on the east, and the Coast Range on the west. It drains a basin with an area of about 27,246 square miles and discharges to the Sacramento San Joaquin Delta (DWR 2009, Volume 3). The Sacramento River basin includes all or portions of 23 of the 58 counties in California. The Sacramento River extends approximately 365 miles from the slopes of Mount Shasta to Chipps Island in the Delta. The watershed also continues upstream of Mount Shasta to include the watersheds of the McCloud and Pit rivers and Squaw Creek.

The San Joaquin River is the second largest river in California. It drains about 32,000 square miles and discharges to the Sacramento–San Joaquin Delta (Bureau of Land Management, Wild and Scenic River Suitability Report for Bakersfield Field Office, California, July 2010). The San Joaquin River basin includes all or portions of 17 counties. The San Joaquin River extends approximately 330 miles

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Number: 1 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 8:49:18 AM

Since during flood events at least 4000 cfs are diverted from the Tulare Lake Basin into the San Joaquin Basin, I believe it should be part of this discussion as well.

from the slopes of the Sierra Nevada near Thousand Island Lake on the Middle Fork to Chipps Island in the Delta. The watershed is hydrologically separated from the Tulare Lake watershed in the southern San Joaquin Valley by a broad ridge between the San Joaquin and Kings rivers.

The Sacramento and San Joaquin rivers join in the Delta and flow through Suisun Bay, San Pablo Bay, San Francisco Bay, and to the Pacific Ocean.

6.1.2 Central Valley Hydrology

The hydrology of the Sacramento River and San Joaquin River basins and Suisun Marsh are described below to support later discussions of environmental consequences associated with potential surface water changes resulting from temporary and permanent footprint of disturbance associated with construction of project water conveyance and related facilities and conservation components, as well as effects on surface water resources stemming from long term operations and existence of facilities and restored areas. The Tulare Lake basin is briefly described although the environmental consequences of the alternatives do not affect the surface waters in this basin.

6.1.2.1 Sacramento River Basin

The Sacramento River flows generally north to south from its source near Mount Shasta to the Delta near Freeport. The Sacramento River receives contributing flows from numerous major and minor streams and rivers that drain the east and west sides of the basin, including creeks upstream of the confluence with the Feather River (Cow, Battle, Cottonwood, Mill, Thomes, Deer, Stony, Big Chico and Butte creeks), Feather River (including flows from Yuba and Bear rivers), American River, ah Creek that flows into Yolo Bypass which subsequently flows into the Cache Slough complex prior to flowing into the Sacramento River upstream of Rio Vista, as shown in Figure 6 3.

Sacramento River basin topography ranges in elevation from approximately 14,000 feet above sea level on Mount Shasta to approximately 1,070 feet at Shasta Dam to sea level in the Delta, as shown in Figure 6 2. Generally, precipitation occurs in the form of snow during winter and early spring at elevations above 5,000 feet. The snowmelt generally occurs in April and May.

As described in Chapter 5, Water Supply, flows in the Sacramento River are regulated by operation of Shasta and Keswick dams. Water diverted from Trinity River enters the Sacramento River through Keswick Reservoir. Major tributaries in the reach between Keswick Dam and Red Bluff include Clear and Cottonwood creeks on the west and Battle, Bear, Churn, Cow, and Payne creeks on the east. Major tributaries along the reach of the Sacramento River between Red Bluff and Verona are Antelope, Mill, Deer, Big Chico, Rock, and Pine creeks on the east and Reeds, Red Bank, Elder, Thomes, and Stony creeks on the west. The most northern of three flood bypass channels along the Sacramento River, Butte Basin, also is located in this reach.

The Feather River flows into the Sacramento River immediately upstream of Verona. The Feather River watershed is approximately 3,607 square miles and located on the east side of the Sacramento Valley (Reclamation 1997, p. III 5). The Feather River is the largest tributary to the Sacramento River below Shasta Dam. The Yuba River is a major tributary to the Feather River and flows into the Feather River near the town of Marysville (Reclamation 1997, p. III 5). The Yuba River watershed is approximately 1,339 square miles. The Bear River is another major tributary to the Feather River. As described in Chapter 5, Water Supply, flows in the lower Feather River are regulated by operations of Oroville and Thermalito dams and diversions by Western Canal, Richvale Canal, the Pacific Gas and Electric Company (PG&E) Lateral, and the Sutter Butte Canal.

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Number: 1 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 8:56:20 AM

Cache Creek should also be mentioned at this point.

Number: 2 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 9:08:01 AM

Wikipedia lists Bear River watershed as 295 square miles.

Number: 3 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 9:33:06 AM

Yuba River flows are regulated primarily by New Bullards Bar Dam.

Number: 4 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 9:20:55 AM

I don't believe I would call Butte Basin a Bypass as it is the natural basin taking water from Little Chico Creek, Butte Creek and Cherokee Canal from the east and diverted water from Sacramento River through Moulton Wier and Colusa Wier. The Butte Basin drains to the south into the manmade Sutter Bypass. The Sutter Basin (the natural overflow area of the Sacramento River is west of the Sutter Bypass.

During flood events, a portion of the Feather River waters flow into the Tisdale Bypass and the associated Sutter Bypass, the second of the three floodbypass channels along the Sacramento River.

Downstream of Verona, the Sacramento River continues to the Delta. At the Fremont Weir, downstream of Knights Landing and upstream of Sacramento, a portion of the Sacramento River water flows into the Yolo Bypass during flood events. Yolo Bypass conveys flood flows from the Sacramento River and Sutter Bypass to Cache Slough for continued conveyance into the Sacramento River upstream of Rio Vista. The Sacramento Weir and Bypass conveys flood flows from the Sacramento River downstream of Fremont Weir and upstream of American River into Yolo Bypass. Yolo Bypass also conveys water from Knights Landing Ridge Cut, Willow Slough and Willow Slough Bypass, and Cache and Putah creeks located along the northern and western boundaries of Yolo Bypass. The capacity of the Yolo Bypass ranges from 343,000 cubic feet per second (cfs) downstream of Fremont Weir to 500,000 cfs near Rio Vista. The eastern boundary of the Yolo Bypass is formed by the levees of the Sacramento River Deep Water Ship Channel that was constructed in 1963. The bypass was inundated 46 years out of the 65 years between 1935 and 1999 (CALFED 2000a).

The American River watershed is approximately 1,895 square miles. The American River joins the Sacramento River at the City of Sacramento approximately 20 miles downstream of Verona. As described in Chapter 5, Water Supply, flows in the lower American River are regulated by operation of Folsom and Nimbus dams. American River flows are regulated upstream of Folsom Lake by operations of several reservoirs owned and operated by Placer County Water Agency, El Dorado Irrigation District, and Sacramento Municipal Utility District.

The Sacramento River enters the Delta near Freeport downstream of the American River confluence. The flows at Freeport include the effects of upstream diversions to the Yolo Bypass. Flood channel capacity of the Sacramento River at Freeport is 80,000 cfs (DWR 2005).

Flows from the Yolo Bypass reenter the Sacramento River upstream of Rio Vista. Flows in the Sacramento River between Freeport and Rio Vista can be depleted by flows diverted through the Delta Cross Channel and Georgiana Slough when the SWP/CVP south Delta intakes are operational.

The surface water and groundwater systems in the Sacramento Valley are very strongly connected, as described in Chapter 7, Groundwater. The typically high groundwater levels in the Sacramento Valley cause the major rivers and the lower reaches of many of the tributary streams to gain flow through groundwater discharge. Surface water also seeps from the streams into the groundwater where groundwater elevations are lower than the stream water elevation and the surrounding soils are porous. The quantities of groundwater that discharge into surface streams and the quantities of surface water that percolate into underlying aquifers change temporally and spatially, and are poorly understood. Estimates of these surface water/groundwater exchange rates have been developed for specific reaches on a limited number of streams in the Sacramento Valley (USGS 1985), but a comprehensive valley wide accounting has not been performed to date.

6.1.2.2 San Joaquin River Basin

The San Joaquin River originates in the Sierra Nevada and then flows west into the San Joaquin Valley through Millerton Lake at Friant. The San Joaquin River turns north near Mendota and flows through the San Joaquin Valley and into the Delta near Vernalis. The San Joaquin river receives contributing flows from the Fresno, Chowchilla, Merced, Tuolumne, Stanislaus, Calaveras,

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Number: 1 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 9:27:51 AM

Actually a majority of the Sacramento River is diverted at the Fremont weir into the Yolo Bypass as the capacity of the Sacramento River downstream of the Fremont Weir is only 107000 cfs while the capacity of the Fremont Weir is 343000 cfs.

Number: 2 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 9:05:40 AM

Feather River does not flow into the Tisdale Bypass. During high flow a portion of the Sacramento River does flow into the Tisdale Bypass.

Number: 3 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 9:40:57 AM

I don't believe the Chowchilla River actually drains into the San Joaquin River but rater is diverted into Ash and Berenda Sloughs which do discharge into the San Joaquin River.

Mokelumne, and Cosumnes rivers, as shown in Figure 6 4. The Calaveras, Mokelumne, and Cosumnes rivers flow into the San Joaquin River within the boundaries of the Delta.

The San Joaquin River basin topography ranges in elevation from over 10,000 feet above sea level in the Sierra Nevada to sea level in the Delta. Generally, precipitation occurs in the form of snow during winter and early spring at the upper elevations and snowmelt occurs in the late spring and early summer months. As described in Chapter 5, Water Supply, flows in the San Joaquin River are regulated by operation of Friant Dam, which diverts water into the CVP Friant Division (as described in Chapter 5, Water Supply) that conveys water in the Madera Canal to the north and the Friant Kern canal to south for irrigation and municipal and industrial water supplies in the eastern portion of the San Joaquin Valley, and releases water in the San Joaquin River meet downstream water rights and instream flow requirements. Hydropower generation facilities in the upper reaches of the San Joaquin river influence water flows into Millerton Lake (formed by Friant Dam). The water supply to the Friant Division was made available through an agreement with San Joaquin River water right holders (Exchange Contractors), who entered into an exchange contract and purchase agreement with Reclamation for delivery of water through the Delta Mendota Canal. Flood control releases from Friant Dam may be used to satisfy portions of deliveries to the San Joaquin River Exchange Contractors. Millerton Lake operations are coordinated with operations of the Delta Mendota Canal to manage releases, including flood control releases for the Exchange Contractors and other CVP water users (Reclamation 1999, p. 13 15).

In the San Joaquin River reach between Friant Dam and to locations upstream of Mendota Pool, including Gravelly Ford, flows in the river have historically been extremely low or not discernible from the surface. The ongoing San Joaquin River Restoration Program is developing a comprehensive long term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River, ensure irrigation supplies to water diverted from Friant Dam, and restore a self sustaining fishery in the San Joaquin River. The San Joaquin River Restoration Program is a direct result of a September 2006 settlement on litigation to provide sufficient fish habitat in the San Joaquin River below Friant Dam between the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority. Federal legislation was reintroduced on January 4, 2007, to authorize federal agencies to implement the settlement. Interim flows began October 1, 2009, and full restoration flows are scheduled to begin no later than January 2014 (DWR 2009, p. SJ 12).

A portion of the San Joaquin River flow is diverted into several bypasses during flood events. Upstream of the Mendota Pool and Mendota Dam, a portion of the flow is diverted into the Chowchilla Bypass that conveys water into the Eastside Bypass for further conveyance through Mariposa and Deep sloughs prior to discharge into the San Joaquin River near the confluence with the Merced River.

Fresno River flows from the Sierra Nevada foothills near Madera to Hensley Lake that is formed by Hidden Dam. Hidden Dam operations regulate the downstream Fresno River flows that flow into the Eastside Bypass and subsequently into the San Joaquin River near the confluence with the Merced River.

Chowchilla River flows approximately parallel to Fresno River from the Sierra Nevada foothills and flows into Eastman Lake formed by Buchanan Dam. Operations of the dam regulate the downstream reaches of the Chowchilla River that flows into the San Joaquin River downstream of the City of Chowchilla and upstream of the confluence of the Merced River and the San Joaquin River.

Number: 1 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 10:27:45 AM

Note at least 4000 cfs can enter the San Joaquin Watershed from the Tulare Lake Watershed through the Fresno Slough Bypass vis the Fresno Slough.

Number: 2 Author: L2EDEEAK Subject: Sticky Note Date: 4/17/2012 10:39:34 AM

Duck Slough, Owens Creek and Bear Creek and minor tributaries provide input into the San Joaquin River as well.

Number: 3 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 9:52:03 AM

The majority of the San Joaquin River flow is diverted into the Chowchilla Canal Bypass as 5500 cfs is the capacity of the bypass and the capacity of the San Joaquin River is only 2500 cfs and their juncture.

The Merced River originates in the Sierra Nevada and drains an area of approximately 1,273 square miles east of the San Joaquin River. Flows in the lower Merced River are regulated by operations of New Exchequer Dam that forms Lake McClure and three downstream dams. The Merced River is operated to meet water rights demands and instream flows and generate hydropower (Reclamation 1999, p. 3 8). The Merced River flows into the San Joaquin River downstream of the confluences with Deep Slough and Salt Slough.

The Tuolumne River drains a watershed in the Sierra Nevada of approximately 1,540 square miles. Flows in the upper Tuolumne River are regulated by the operation of O'Shaughnessy Dam that forms the Hetch Hetchy Reservoir and is diverted into Hetch Hetchy conveyance system that is owned and operated by the San Francisco Public Utilities Commission. Flows in the lower Tuolumne River primarily are regulated by the operation of New Don Pedro Dam that forms Lake Don Pedro. The Tuolumne River is operated to meet water rights demands in the watershed, water rights held by San Francisco Public Utility Commission, and instream flows; and to generate hydropower. The Tuolumne River flows into the San Joaquin River upstream of Modesto.

The Stanislaus River originates in the Sierra Nevada and drains a watershed of approximately 900 square miles. Snowmelt runoff contributes the largest portion of the flows in the Stanislaus River, with the highest monthly flows in April through June. Flows are regulated by New Melones Dam that forms New Melones Reservoir, and is operated as part of the CVP as described in Chapter 5, Water Supply. Releases from New Melones Dam are reregulated by operations of the downstream Tulloch and Goodwin dams. Stanislaus River is operated to meet water rights demands in the watershed, water rights held by Central San Joaquin Water Conservation District and the Stockton East Water District through CVP water service contracts, and instream flows; and to generate hydropower. The Stanislaus River flows into the San Joaquin River downstream of Modesto.

The San Joaquin River continues to flow to Vernalis. This reach of the river is influenced by flows from the San Joaquin River and return flows from agricultural operations that are supplied water from the San Joaquin River and the CVP Delta Mendota Canal. Vernalis is the location where the San Joaquin River enters the Delta. Flood warning levels occur on the San Joaquin River at 3[illegible]0 cfs. When the San Joaquin River flows at Vernalis exceeds 15,000 cfs, flows are diverted into Paradise Cut (south of the City of Lathrop). Downstream of Paradise Cut, the San Joaquin River splits into several channels including the main river channel that flows Lathrop and Stockton; Middle River; and Old River. The Middle River and Old River channels are used by the SWP/CVP system to convey water from the Sacramento River to the SWP/CVP south Delta intakes, as described in Chapter 5, Water Supply. Middle River and Old River reconnect with the San Joaquin River downstream of the South Fork Mokelumne River and upstream of North Fork Mokelumne River.

The Calaveras River originates in the Sierra Nevada and drains an area of approximately 363 square miles. The Calaveras River watershed is almost entirely below the effective average snowfall level (5,000 feet) and receives nearly all of its flow from rainfall. As a result, nearly all of the annual flow occurs between December and April. Flows in the lower Calaveras River are regulated by New Hogan Dam that forms New Hogan. The Calaveras River is operated to meet water rights demands and instream flows, and flows into the San Joaquin River in the City of Stockton.

The Mokelumne River originates in the Sierra Nevada and drains a watershed of approximately 661 square miles. Flows in the Mokelumne River are regulated by several upstream reservoirs including Salt Springs Reservoir on the North Fork Mokelumne River, operated by Pacific Gas & Electric Company to generate hydropower; and Pardee and Camanche reservoirs are on the main

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Number: 1 Author: L2EDEEAK Subject: Sticky Note Date: 4/17/2012 10:40:48 AM
Where on the San Joaquin River is this 32500 cfs measured? Vernalis?

Number: 2 Author: L2EDEEAK Subject: Sticky Note Date: 4/16/2012 10:02:40 AM
flows "west of" Lathrop and Stockton?

Number: 3 Author: L2EDEEAK Subject: Sticky Note Date: 4/17/2012 10:41:46 AM
It forms New Hogan "Lake"

Number: 4 Author: L2EDEEAK Subject: Sticky Note Date: 4/17/2012 10:39:57 AM
Merced River originates in Yosemite National Park.

stem of the Mokelumne River, operated by East Bay Municipal Utility District to export water to their service area in the eastern San Francisco Bay Area. Downstream of these reservoirs, the Mokelumne River is operated to meet water rights demands in the watershed and instream flows, including flow requirements for salmonid fish hatchery operated by East Bay Municipal Utility District. The mainstem Mokelumne River splits into the North and South Forks of the Mokelumne River at the southernmost tip of McCormack Williamson Tract near New Hope Landing. The North and South Forks of the Mokelumne River flow south and converge at the southwestern tip of Staten Island. The Mokelumne River terminates in the San Joaquin River south of Bouldin Island in the Delta. Water from the Sacramento River is conveyed into the Mokelumne River system through the operable gates at the CVP Delta Cross Channel (see Chapter 5, Water Supply) and Georgiana Slough which are located along the Sacramento River at Walnut Grove.

A major portion of the Cosumnes River water flows into the Mokelumne River near Thornton and a portion flows into the Sacramento River upstream of Walnut Grove through Lost Slough. The Cosumnes River originates in the lower elevations of the Sierra Nevada and drains a watershed of approximately 537 square miles. The Cosumnes River receives most of its water from rainfall. The Cosumnes River flows are not regulated by major facilities, although Sly Park Reservoir is located in the upper watershed to provide local water rights demands. Flows from the Cosumnes River are used by water rights holders in the watershed including several managed wetland areas.

The San Joaquin River flows through the Delta channels and joins the Sacramento River near Collinsville and flows into Suisun Bay. Several local tributaries flows form the Delta lowlands into the San Joaquin River within the Delta include Mosher Creek, Bear Creek, Duck Creek, Pixley Slough flow and Disappointment Slough.

6.1.2.3 Delta Hydraulics

The Delta is a complex network of over 700 miles of tidally influenced channels and sloughs. Three strong forcing mechanisms drive circulation, transport, and mixing of water in the Delta: (1) freshwater river flow from drainages to the Delta; (2) tides propagating from the Pacific Ocean through San Francisco Bay from the west; and (3) SWP and CVP water supply facilities operating in the south Delta (USGS 2005). Flow gages are located throughout the Delta, as shown in Figure 6 5.

Influence of Delta Inflows

North Delta channels convey river flows that move south and west through the Sacramento River to the Delta. The Delta Cross Channel gates divert flows from the Sacramento River to facilitate flow toward the SWP/CVP south Delta intakes. Channel flows in the southern Delta are sensitive to export operations. Pumping can slow or reverse flows that would naturally go north and west in the San Joaquin River and associated channels towards the Delta. Temporary barriers and tidal flow throughout the Delta add further complexity to the circulation and mixing of waters (USGS 2005).

Influence of Delta Tidal Flows

Tidal flows have a major influence on Delta hydraulics and vary with the extent of high and low tides. On average, tidal inflows to the Delta are approximately equal to tidal outflows. All tidal flows enter and leave the Delta along the San Joaquin River at Chipps Island.

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Sea level rise is another factor that has a notable influence on Delta hydraulics. Factors affecting sea level rise include tidal variations, storm surges, large-scale changes in water temperature and wind forces, and climate-related changes. Sea level has been rising at various rates over at least the past 20,000 years, with the most rapid rise of about 120 meters occurring from about 18,000 to 5,000 years ago. Data from a collection of tide gages indicate a global sea level rise rate of approximately 1.8 millimeters per year during the twentieth century. For the period from 1993 to 2003, the global sea level rise rate is estimated to be approximately 2.8 millimeters per year using satellite altimetry data. Data from tectonically stable tide gages in California and other West Coast locations in the United States show similar rates. The occurrence of extremes in sea level rise has increased markedly since the early 1900s (Cayan et al. 2008).

Influence of SWP and CVP Delta Operations

The withdrawal rates at the south Delta intakes significantly influence Delta hydraulics and can change the direction of flow of some waterways in the south Delta. The most significant effects occur on Old and Middle Rivers, as described in Chapter 5, Water Supply. Reverse flows also occur in False River in the western Delta and Turner Cut Off in the San Joaquin River.

South Delta Channels and Barriers

The south Delta hydraulics are influenced by several channels that have been widened and/or connected and barriers to reduce connectivity between other channels to protect agricultural water uses or aquatic resources. Operations of these facilities affect operations of the SWP and CVP south Delta intakes.

Grant Line Canal and the Fabian and Bell Canal run in parallel and are commonly collectively referred to as the Grant Line Canal. The Grant Line Canal conveys flow from the San Joaquin River to the CVP south Delta intakes. The Grant Line Canal is approximately 9 miles long. The Fabian and Bell Canal begins near the Tracy Boulevard Bridge and continues to the downstream end of the Grant Line Canal, where it rejoins the Old River Channel just upstream of the Clifton Court Forebay. Approximately half of the flow diverted at the SWP/CVP south Delta intakes flows past Grant Line Canal through the portion of the Old River extending from Victoria Island to Bacon Island.

Middle River is a relatively narrow and shallow channel that extends from Victoria Canal to the San Joaquin River. In the lower 4 miles, from Victoria Canal to between the Tracy Boulevard and the Howard Road bridges, the channel has been dredged deeper and wider (DWR 2005).

Paradise Cut is a tidal slough located north of Tracy, approximately 6 miles long. It connects the San Joaquin and Old rivers.

Tom Paine Slough is isolated from tidal influences by siphons. It essentially operates as a lake, supplying approximately ten irrigation diversions. Portions of the channel have been dredged by Department of Water Resources (DWR) and South Delta Water Agency and siphons have been installed. In an effort to increase the water level maintained in Tom Paine Slough during unusually high tides, the gate operations were modified (DWR 2005).

Operation of barriers within the Delta has affects on water levels and flow and circulation patterns. The purposes of the barriers and gates are to:

- Raise water surfaces for irrigation diversions
- Control flow to local agricultural pumping plants

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- Prevent fish from entering certain channels (fish protection)
- Affect circulation patters that can improve water quality

The locations of barriers and gates in the Delta are shown in Figure 6-6.

In the south Delta, four temporary rock barriers are installed annually. The barriers include openings that allow a portion of the flow to pass downstream, but most flow is redirected into other channels. The four barriers historically have been installed at Head of Old River Gate, Old River at Tracy Gate, Middle River Gate, and Grant Line Canal Gate. The Head of Old River Gate (also referred to as the Head of Old River Barrier, see Chapter 5, Water Supply) is intended to prevent the movement of Chinook Salmon into the southern Delta channels via the Old River and to reduce channel water salinity. This gate is operated from April to May and September to November each year. The other three barriers (besides the Head of Old River Gate) are agricultural gates that are operated between April 15 and November 30 each year and during other periods of high tide and flooding as needed. These gates benefit agriculture within the Delta by maintaining required water levels and improving circulation patterns, which can help improve water quality.

6.1.2.4 Suisun Marsh

Suisun Marsh is the largest contiguous brackish water marsh in North America, encompassing approximately 180 square miles comprising managed wetlands, upland grasses, tidal wetlands, bays, and sloughs. Suisun Marsh is located west of the Delta. Water Right Decision 1485 (D-1485) issued by the State Water Resources Control Board in 1978 established channel water salinity standards and a water quality monitoring program and provided for the recently adopted Suisun Marsh Habitat Management, Preservation, and Restoration Plan (Reclamation 2011).

Suisun Marsh originally consisted of a group of islands separated by sloughs with inflow from tides and floods. In the 1860s and under federal and State legislation, reclamation of the swamps was accomplished through construction of a complex system of levees to develop managed seasonal wetlands and agriculture.

Both tidal and freshwater flows are conveyed into the marsh though an extensive network of sloughs. Green Valley, Suisun, Dan Wilson, Ledgewood, McCoy, and Denverton creeks flow into Suisun Marsh from surrounding lands.

Several facilities have been constructed by DWR and Reclamation to maintain freshwater conditions in many portions of Suisun Marsh, including Suisun Marsh Salinity Control Gates, Morrow Island Distribution System, Roaring River Distribution System, Goodyear Slough Outfall, Lower Joice Island Unit, and the Cygnus Unit. The Suisun Marsh Salinity Control Gates are the primary facilities to maintain freshwater conditions and reduce tidal flows from Grizzly Bay into Montezuma Slough during incoming tides, and divert low salinity water from the Delta into Montezuma Slough. The Suisun Marsh Salinity Control Gates historically have operated from early October through May, depending on salinity conditions. The Roaring River Distribution System is designed to tidally pump water from the eastern end of Montezuma Slough to provide for the seasonal water needs of Suisun Marsh landowners and fisheries. The Morrow Island Distribution System consists of two channels that divert water from Goodyear Slough to the easternmost part of Morrow Island. Lower salinity water from Goodyear Slough is pumped into seasonal wetlands and drained into Grizzly Bay or Suisun Slough to prevent high-salinity drainage water from entering Goodyear Slough. The Goodyear Slough outfall connects the southern end of Goodyear Slough to Suisun Bay, which

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increases circulation and reduces salinity in Goodyear Slough. The Lower Joice Island Unit intake culverts on Montezuma Slough and on Suisun Slough near Hunter Cut divert water into a managed wetland area. The Cygnus Unit was constructed to provide drainage to another area of Suisun Marsh.

6.1.2.5 Tulare Lake Basin

The Tulare Lake watershed consists of approximately 17,000 square miles located at the southern end of the San Joaquin Valley (DWR 2009, p. TL 5). It is an area bounded by the Sierra Nevada to the east, the Tehachapi Mountains to the south, and the Coast Ranges to the east (DWR 2009, p. TL 5). Historically, the Kings, Kaweah, and Tule rivers flowed into the Tulare Lake Bed, and the Kern River flowed into the Kern, Buena Vista, and Goose lake beds or into adjacent wetlands and marshes (DWR 2009, p. TL 5). Development of water supply and flood control projects on these rivers and drainage facilities in the lake beds transformed the lake beds into productive agricultural lands.

The Kings River, originating in Kings Canyon National Park, is regulated by Pine Flat Reservoir. Downstream of the reservoir, the South Fork flows to the Tulare Lake bed, and the North Fork flows to Fresno Slough (Reclamation 1997, p. II 56). During periods with flood releases from Pine Flat Reservoir, portions of Kings River flow are diverted through the James Bypass/Fresno Slough system to the San Joaquin River basin (DWR 2009, p. TL 7); or may flow through Fresno Slough to Mendota Pool along the San Joaquin River (Reclamation 1999, p. 13 15). It is only under these conditions that the Tulare Lake basin has a surface water outflow.

The Kaweah River, originating in Sequoia National Forest, is regulated by Kaweah Lake and flows into the Tulare Lake bed (DWR 2009, TL 7). The Tule River, also originating in Sequoia National Forest, is regulated by Lake Success and also flows into the Tulare Lake bed (DWR 2009, TL 7).

The Kern River originates in the Inyo and Sequoia National Forests and Sequoia National Park, and is regulated by Lake Isabella. The Kern River flows into the Kern Lake bed and continues to flows into the Buena Vista and Tulare Lake beds (DWR 2009, TL 7). Flows from the Kern River also may be diverted to the SWP California Aqueduct through the Kern River Intertie (DWR 2009, TL 7).

6.1.3 Central Valley Flood Management

Operations of surface waters in the Central Valley are affected by water supply requirements, as described in Chapter 5, Water Supply, and flood management operations, as described in this section.

6.1.3.1 Background of Central Valley Flood Management

Development of the Delta began in 1848 to provide food for the communities that were established during the Gold Rush in the California foothills. In 1850, the Swamp and Overflowed Lands Act was passed by Congress, ceding federal swamplands to the states to encourage reclamation. In 1868, the State Tideland Overflow and Reclamation Act passed by the California Legislature enabled the creation of local reclamation districts, which led to the transfer of much of this public land into private ownership. Most of the original levees constructed to reclaim wetlands in the Delta during the mid 1800s were less than 5 feet high (Thompson 1982). These small levees initially allowed the marshlands to be drained and farmed. Later, large steam driven clamshell dredges were used to build and enlarge the levees to increase flood protection and to combat levee and land subsidence.

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it is also boarder "on the north by a broad ridge between the San Joaquin and Kings rivers"

In some areas of the Delta, organic peats and mucks used in this construction were not ideal levee construction materials, and seepage problems commonly developed. Organic soil material commonly shrank or compressed with placement of additional levee fill. Construction of the levees on the soft soil often resulted in irregular settlement and the creation of large cracks and fissures in levee and foundation soils. The surfaces of the reclaimed land also subsided as a result of oxidation of the organic soils. Levees required constant maintenance to overcome the land subsidence and settling.

Hydraulic mining in the Sierra Nevada, beginning around 1853 and lasting approximately three decades, washed vast amounts of material into the streams and canyons, resulting in reduced channel capacity downstream and increased flooding in the Sacramento Valley and the Delta. In 1893, the California Debris Commission was established to regulate hydraulic mining, planning for improved navigation, deepen channels, protect river banks, and afford relief from flood damages. The California Debris Commission began surveys of Sacramento Valley streams in July 1905 and developed a flood management plan in 1907. The plan included constructing and enlarging levees along rivers, creating bypasses to convey flows greater than the river's capacity, and dredging the Sacramento River to Suisun Bay. The California Debris Commission had an influential role in the history of flood management, but was terminated in 1986, and all its responsibilities were reassigned to the U.S. Army Corps of Engineers (USACE) (Kelley 1998).

Use of steam powered dredges began in the Delta in the 1870s and continued for many decades (Dutra 1980). The general approach was to dredge alluvial sediments in the sloughs and rivers and deposit the wet, unconsolidated material on the levee. After the dredged material dried out, it would be shaped into an overall levee cross section. Today, many levees in the central Delta still require periodic placement of new fill to meet specific design criteria to maintain flood protection.

The failure rate of Delta levees was generally greater in the early part of the twentieth century than during the latter half for several reasons:

- The construction of upstream storage reservoirs by the mid 1960s helped attenuate flood flows into the Delta.
- The construction of the two federal flood control projects significantly improved about a third of the levees in the Delta.
- Some of the islands that flooded in the early part of the century were not reclaimed. Consequently, this diminished the potential number of levee failures.
- The State began funding the Delta Levee Subventions and Special Projects programs in the 1980s as a result of ongoing levee failures. These grant monies helped fund levee maintenance and improvements in many areas of the Delta.
- More attention and resources have been given to flood fighting and responding to levee problems in the Delta.

In most levee failures, the breaches in the levees were repaired by either the USACE or by the local reclamation districts. Some islands were not reclaimed after flooding caused by levee failures, including:

- Western Sherman Island, approximately 5,000 acres, inundated in 1878
- Big Break, approximately 2,200 acres, inundated in 1927
- Franks Tract, approximately 3,300 acres, inundated in 1938

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by the Water Resource Development Act of 1986 the California Debris Commission was terminated.

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"by an act of congress" the California Debris Commission was formed.

- Mildred Island, approximately 1,000 acres, inundated in 1983
- Little Franks Tract, approximately 330 acres, inundated circa 1983
- Little Mandeville Island, approximately 376 acres, inundated in 1986
- Liberty Island, 5,209 acres, inundated in 1998

After the floods of 1986, the USACE stated that it would no longer reclaim flooded islands that were protected by nonproject levees (levees not authorized or constructed under a federal flood control project). In 2004, after the Jones Tract levee failure occurred, DWR repaired the breach and pumped out the floodwaters inundating the two tracts (DWR 1995). The total cost of island and damage recovery was nearly $90 million (DWR 2008b).

Today, approximately 1,115 miles of levees protect 700,000 acres of land within the legal limits of the Delta, and approximately 230 miles of levees protect about 50,000 acres of the Suisun Marsh.

6.1.3.2 Flood Management Facilities in the Central Valley and the Delta

Upstream reservoirs, flood bypasses, and levees affect hydrology and flood management in the Central Valley and the Delta. Nineteen major multipurpose dams and two major flood management projects, Sacramento River Flood Control Project and the San Joaquin River Flood Control Project, reduce peak flows in the Sacramento and San Joaquin rivers and their tributaries, and the Delta. The levees built as part of these projects are designated as "project levees" and are maintained by State and local public agencies, as shown in Figure 6 7. Approximately 1,600 miles of project levees are part of the Central Valley federal flood control projects, of which 385 miles are in the Delta. The remaining levees are designated as "nonproject levees," as shown in Figure 6 7, and are maintained by local districts. Flood flows are conveyed through the Delta and into San Francisco Bay for continued conveyance through the Golden Gate to the Pacific Ocean.

Flood management in the Delta also involves management of seepage water from Delta channels into the islands. If left unmanaged, this seepage could flood the islands. Excess seepage is pumped from the islands into the Delta channels.

Sacramento River Flood Control Project

The Sacramento River Flood Control Project extends from the Sacramento River watershed along the Sacramento River and into the Delta and consists of the following features:

- Approximately 980 miles of levees along the Sacramento River, extending from Collinsville to Chico Landing (at River Mile 194), and the lower reaches of the major tributaries (American, Feather, Yuba, and Bear rivers), minor tributaries, and distributary sloughs in the Delta
- Moulton, Colusa, Tisdale, Fremont, and the Sacramento flood overflow weirs
- Butte Basin, Sutter, and Yolo bypasses and sloughs

The principal features of the Sacramento River Flood Control Project extend from Ord Bend upstream of Yolo Bypass downstream to Collinsville, a distance of 184 river miles. These features include a comprehensive system of levees, overflow weirs, drainage pumping plants, and flood bypass channels (USACE 1992). The flood bypass channels, to a certain extent, mimic natural and historical flooding patterns. The project levees begin on the western bank just downstream of Stony Creek. Upstream of the levees, high flows on the river flow to the east into the Butte Basin, a trough

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Most of the levees were not built as part of the Flood Control Project but rather adopted into the system. Primarily the levees built along the bypasses were constructed as part of the flood control projects. In the Delta those levees which are located along the navigation channels are part of the flood control project.

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Butte Basin is a natural "bypass".

created by subsidence. The Colusa Basin Drain, a similar trough located to the west of the river, intercepts runoff from westside tributaries.

The Tisdale Weir is usually the first flood overflow structure to spill. When the Sacramento River reaches 23,000 cfs, flows spill over the Tisdale Weir, through the Tisdale Bypass, and into the Sutter Bypass.

During major flood events, the major upstream reservoirs (including Shasta, Folsom, Oroville, Black Butte, and New Bullards Bar) intercept and store initial surges of runoff and provide a means of regulating flood flow releases to streams with levees, channels, and bypass floodways. To achieve the full flood flow regulating benefits of the reservoirs, specific downstream channel capacities must be maintained. Reservoir operations are coordinated not only among various storage projects but also with downstream channel and floodway carrying capacities.

The Central Valley Flood Protection Board (CVFPB) agrees to maintain and hold the USACE harmless for failure of the project levees, but the CVFPB would not pursue the hold harmless clause unless a local public agency agrees to maintain the levees and holds the state harmless pursuant to Water Code 12642. The exceptions are described in Water Code section 12878 for state maintenance areas where the locals are assessed for the cost of the maintenance, and Water Code section 8361 which identifies units of the Sacramento Flood Control Project that DWR is required to operate and maintain (DWR 1995).

Yolo Bypass

The Yolo Bypass is an operative feature of the Sacramento River Flood Control Project, which was originally authorized by the Flood Control Act of 1917 and modified by various Flood Control and River and Harbor Acts in 1928, 1937, and 1941. The Yolo Bypass is located immediately west of the metropolitan area of Sacramento and lies in a general north-to-south orientation extending from the Fremont Weir (upstream of the Delta) downstream to Liberty Island (within the Delta), a distance of about 43 miles. The Yolo Bypass encompasses about 40,000 acres and varies in width from about 7,000 feet near the Fremont Weir to about 16,000 feet at Interstate 80.

During high flows in the Sacramento River, water enters the Yolo Bypass via the Fremont and Sacramento weirs. Additional flows enter from the west along tributaries, including Willow Slough, Willow Slough Bypass, and Putah Creek. Waters flows from the Yolo Bypass into the Sacramento River upstream of Rio Vista. The Yolo Bypass is flooded about once every 3 years, on average, and flood flows generally occur during the winter months of December, January, and February. Local surface waters in the Yolo Bypass flow through the Tule Canal and Toe Drain, which are west of the Sacramento Deep Water Ship Channel. The USACE and the CVFPB regulate the Fremont Weir, Sacramento Weir, and the flood-carrying capacity of the Yolo Bypass. DWR is responsible for maintaining and operating those portions of the Sacramento River Flood Control Project.

Sacramento River Project Levees in the Delta

Project levees in the northern Delta are primarily part of the Sacramento River Flood Control Project. The Sacramento River Flood Control Project was authorized by Congress in 1917 and was initially completed by USACE in 1960. The CVFPB, in conjunction with DWR and local reclamation districts, operates and maintains the project levees under an agreement with USACE (DWR 1995).

The Sacramento River Flood Control Project levees in the Delta include levees that protect, or partially protect, the following: West Sacramento, City of Sacramento, Walnut Grove, Courtland,

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Knights Landing Ridge Cut and Cache Creek also flow into the Yolo Bypass.

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How does the Paterno Decision effect this discussion?

Clarksburg, Ryde, Hood, lands between the Sacramento River and the Sacramento River Deep Water Channel (east levee of the Deep Water Ship Channel), Merritt Island, Sutter Island, Grand Island, Ryer Island, Tyler Island, Hastings Tract, Prospect Island, Brannan Island, Twitchell Island, Pierson Tract, and Sherman Island (DWR 1993).

San Joaquin River Flood Control Project

The San Joaquin River Flood Control System, or Project, as defined in Water Code section 12668 extends from Friant Dam along the San Joaquin River to the Stockton Deep Water Ship channel, and in that area of the North Fork of the Kings River and Mendota Pool from the southerly boundary of the James Reclamation District Number 16060 to Mendota Dam.

Other flood control features that effect the San Joaquin River include the Chowchilla Canal and the Eastside Bypass divert upper San Joaquin River flows and intercept streams draining the central Sierra Nevada. (USACE 2002).

The Lower San Joaquin River Flood Control Project was authorized by Congress in 1944 and includes levees that protect, or partially protect, Stockton, Lathrop, Manteca, Tracy, Stewart Tract, Upper Roberts Island, Middle Roberts Island, Lower Roberts Island, Pescadero District, and Union Island (USACE 2008a, 1999).

Nonproject Levees in the Delta and Suisun Marsh

Most of the levees in the Delta are nonproject levees, comprising 730 miles out of 1,115 miles. In Suisun Marsh, all of the approximately 230 miles of the levees are nonproject levees. These levees are not part of the federal flood control program and are maintained by local public reclamation districts (some are regulated by CVFPB and none are affiliated with Reclamation). Some of the maintenance activities are partially reimbursed by DWR under the Delta Levee Subventions Program established in 1973. The Delta Flood Protection Act of 1988 significantly increased reimbursement opportunities and added mitigation requirements to ensure no net long term loss of habitat. Improvement and frequent maintenance of these levees are challenging for the reclamation districts because many districts have limited funds to both maintain the levees and protect levee wildlife habitat (DWR 1995).

Nonproject levees also protect portions of the deep water ship channels to the two major inland ports. The Stockton Deep Water Ship Channel was built in 1933 and follows the San Joaquin River past Rough and Ready Island to the Port of Stockton via Stockton Channel. The Sacramento River Deep Water Ship Channel follows the Sacramento River and Cache Slough prior to entering the excavated deep water channel that extends to the Port of Sacramento in West Sacramento. The levees on the east sides of the Sacramento River, Cache Slough, and the Sacramento River Deep Water Ship Channel are project levees. The levees on the west side of the Sacramento River upstream of Rio Vista, west side of Cache Slough, and a portion of the west side of the excavated channel near Cache Slough are nonproject levees.

6.1.3.3 Operation of Water Supply and Flood Management Flow Regulation Facilities in the Central Valley

Regulated flows for a river are the downstream flows that are controlled by major storage reservoirs, dams, or irrigation diversions. Flows into the Delta vary seasonally. High inflows are

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typically observed from mid December until approximately mid April. The low flow season is usually from mid April through mid December (CALFED 2000a).

Both the Sacramento and San Joaquin rivers have large, multipurpose dams, as summarized in Table 6 1. Most of the major dams have flood control storage capacity allocated in their reservoirs (USACE 2002a).

The reservoirs are operated in a manner to reduce the potential of peak flows from multiple tributaries from reaching locations in the river systems simultaneously. The reservoirs are operated in a coordinated manner based upon travel time from the reservoirs to the Delta. On the Sacramento River, the travel time for flows from Shasta Dam on the Sacramento River to the Delta is about 5 days. Travel times from Oroville Dam on the Feather River and New Bullards Bar Dam on the Yuba River to the Delta are 3 days. Travel time from Folsom Dam on the American River and New Melones Dam on the Stanislaus River to the Delta are generally 1 to 2 days. Because of its relative proximity to the Delta, and because the American River provides a large flow contribution, Folsom Dam's operation also can influence on Delta flood management and can increase flows in the Sacramento Bypass that diverts water into the Yolo Bypass.

Water storage in reservoirs that are operated in part for flood control purposes are reduced gradually before the flood season begins in October and November. Reservoirs are operated throughout the winter and spring to reduce flood potential and replenish storage toward the end of the flood season, in March and April.

Seasonal Delta water quality is influenced by the amount and timing of upstream flood flows. Freshwater flows combine with tidal inflows influence the extent of freshwater in the waterways and saltwater in the Delta. At least three types of flood flows may occur in the Central Valley. Winter seasonal flood flows generally affect large portions of the Central Valley from November through April. High spring and early summer snowmelt flood flows originating from the higher elevations of the central and southern Sierra Nevada generally occur about once every 10 years on average from April through June. Local flood flows from strong thunderstorms with very intense rain over a relatively small areas occur from late spring to early fall in some years.

6.1.4 Delta Levee Failure Risks

Levee failures occur due to overtopping, through seepage, under seepage and excessive water pressure on the levees. Excessive seepage potentially leads to creation of holes in or under the levee that allow water to flow from the waterside to the landside of the levee (known as "piping," or internal erosion) and boils. Boils are the water exit point on the island side of the levee when piping occurs. The piping and/or boils can cause loss of large volumes of levee embankment or foundation material that leads to massive levee failure.

No observed Delta levee failures have been directly linked to earthquake loading. However, it should be noted that levees in the Delta area have not yet been subjected to strong earthquake loading. Primarily because of the potential for liquefaction of levee embankments and foundations, it is assumed that an earthquake in the area would pose a significant threat to the Delta water supply, agriculture, and other land uses that rely on intact levees.

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This is not well written. Levees generally fail due to the following mechanisms: overtopping, seepage, erosion, instability, and seismic activity. Overtopping failure occurs when the capacity of the channel is insufficient to carry the flood flow and the water flows over the levee crown. The water flowing over the levee crown and down the landside slope erodes the levee section resulting in levee failure, this is of particular concern on levees built of sand or silt. Seepage failure is cased by water pressure within the levee or foundation large enough to cause material transport resulting in eternal erosion (often characterized by boils) leading to levee failure if unchecked. Failure due to erosion is caused by either wave action perpendicular to the levee or excessive water flow velocity parallel to the levee removing sufficient material that either seepage or instability of the levee failure occurs. Instability can take multiple forms. A slip can occur due to prolonged high water resulting in weakening of the foundation and levee materials such that the driving forces are greater than resisting forces. Instability may also occur when seepage forces cause sloughing of the levee landside slope. Progressive sloughs result in a shortened seepage paths leading to levee failure. Seismic activity may result in levee failure due to liquefaction of the levee or its foundation materials, resulting in excessive deformation or undesirable transverse cracks.

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The flood control storage space is limited. Once the reservoir is full what flows into the reservoir flows out. for this reason USACE prefers the descriptor "reduction" rather than "control".

1 **Table 6 1. Summary of Sacramento and San Joaquin River and Tributary Dams**

Structure Name (Reservoir Name)	Stream	Type of Dam	Storage (TAF)[a]	Maximum Flood Control Storage (TAF)[a]	Owner	Year Constructed
Sacramento River Basin						
Shasta Dam (Shasta Lake)	Sacramento River	Gravity	4,552	1,300	Reclamation	1945
Black Butte Dam (Black Butte Lake)	Stony Creek	Earth	144	136[c]	USACE	1963
New Bullards Bar Dam (New Bullards Bar Reservoir)	Yuba River	Variable Radius Arch	970	170	YCWA	1970
Oroville Dam (Lake Oroville)	Feather River	Earth	3,538	750	DWR	1968
Clear Lake[d] (Clear Lake)	Cache Creek	Gravity	315	0	YCFCWCD	1914
Indian Valley Dam (Indian Valley Reservoir)	North Fork Cache Creek	Earth	300	40	YCFCWCD	1976
Folsom Dam (Folsom Lake)	American River	Gravity	1,010	400[b]	Reclamation	1956
Monticello Dam (Lake Berryessa)	Putah Creek	Variable Radius Arch	1,602	0	Reclamation	1957
San Joaquin River Basin						
Friant Dam (Millerton Lake)	San Joaquin River	Gravity	521	170c	Reclamation	1942
Los Banos Detention Dam (Los Banos Reservoir)	Los Banos Creek	Earth	35	14	Reclamation	1965
Hidden Dam (Hensley Lake)	Fresno River	Earth	90	65	USACE	1975
Buchanan Dam (Eastman Lake)	Chowchilla River	Rockfill	150	45	USACE	1975
New Exchequer Dam (Lake McClure)	Merced River	Rockfill	1,032	350c	Merced ID	1967
Don Pedro Dam (Don Pedro Lake)	Tuolumne River	Rockfill	2,030	340	TID	1971
New Melones Dam (New Melones Lake)	Stanislaus River	Rockfill	2,420	450	Reclamation	1979
Eastside Tributaries						
Pardee Dam (Pardee Reservoir)	Mokelumne River	Gravity	210	N/Ae	EBMUD	1929
Camanche Dam (Camanche Reservoir)	Mokelumne River	Earth	417	200c	EBMUD	1963
New Hogan Dam (New Hogan Reservoir)	Calaveras River	Earth	317	165	USACE	1963
Farmington Dam (Littlejohns Creek)	Littlejohns Creek	Rockfill	52	52	USACE	1951

Sources: USACE1999, 2002a

Notes: DWR = California Department of Water Resources; EBMUD = East Bay Municipal Utility District; ID = Irrigation District; N/A = not applicable; Reclamation = U.S. Bureau of Reclamation; TAF = thousand acre feet; TID = Turlock Irrigation District; USACE = U.S. Army Corps of Engineers; YCFCWCD = Yolo County Flood Control and Water Conservation District; YCWA = Yuba County Water Agency

[a] Storage and flood control storage values are rounded to the nearest 1,000 acre feet.

[b] Interim flood control storage exceeds this amount by as much as 670,000 acre feet. Storage volume varies depending on upstream storage regulation.

[c] Maximum flood control space may vary depending on upstream storage and/or snowpack.

[d] Natural lake with a dam to increase storage.

[e] Total flood control storage can be shared between Camanche and Pardee reservoirs. It is reported for Camanche, the downstream reservoir.

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It is generally believed that the primary seismic hazards in the Delta consist of localized faults and events, and thus it is unlikely that the entire Delta region will be subjected to large motions from any single earthquake. Because of the large areal extent of the Delta and the varying distances from the seismic sources, the Delta will experience different levels of ground shaking and potential associated geologic hazards. In addition, the Delta is underlain by blind thrust faults that are considered active or potentially active, but they are not expected to rupture to the ground surface. For a 100-year return period, controlling seismic sources for Peak Ground Acceleration would include the following fault zones: Southern Midland, Mt. Diablo, Northern Midland, Concord-Green Valley, Hayward-Rodgers Creek, and Calaveras, as described in Chapter 9, Geology and Seismicity.

6.1.4.1 Subsidence

Levee failure risks due to subsidence can be related to overall Delta subsidence, specific levee subsidence, and/or interior island subsidence.

Delta subsidence is an important issue when assessing the levee system. As the landside ground elevation decreases because of subsidence, the water level stays the same. This increase in pressure head through the levee foundation can cause serious issues with regard to seepage, piping, and slope stability. The theoretical volume of space between the ground surface and mean sea level within the Delta islands is referred to as anthropogenic accommodation space and is used to measure the effects of subsidence. The areas most susceptible to subsidence are the central, western, and northern Delta, where thick organic peat layers predominate (PPIC 2008b).

Subsidence of soils beneath the existing levees and settlement of the levee embankment itself are caused by the reduction in soil volume through consolidation of soft, fine-grained soil. The soil experiences increased pressure as the embankment is constructed. Further consolidation occurs as repairs are made and the embankment is raised, as described in Chapter 10, Soils.

Subsidence resulting from the biochemical oxidation of organic soils and wind disturbance is described in Chapter 10, Soils. This process is related to the intense farming and flood control activities within the Delta that have removed moisture from the surficial soils, which have allowed the highly organic peat soil to react with oxygen in the air to produce carbon dioxide and aqueous carbon (DWR 1995). This reaction allows the surficial soil to be displaced by wind. The loss of ground surface elevation because of wind is an important issue in assessing levee stability within the Delta. As the ground surface elevation is lowered, the landside slope of the levee becomes steeper and less stable. The lowered ground surface also increases the hydraulic loading on the levee and foundation.

6.1.4.2 Other Levee Failure Risks

Other potential risks that can affect the performance of levees within the Delta include encroachments, penetrations, excessive vegetation, burrowing animals, and security issues. These potential risks are relatively easy to control with proper implementation of operation and maintenance activities.

Encroachments

Encroachments such as structures or farming practices on or close to the levee can adversely affect the levee. Examples are excavations at or near the toe leading to increased seepage and/or instability and obstructions on the levee crown, which can interrupt access that is important for

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Define localized.

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There are two mechanisms taking place. The island floors are subsiding due to a number of factors, primarily due to oxidation of the organic soils. The levees are settling due to consolidation of the underlying soils. The soils consolidate in response to the increased soil pressure due to the continued need to add more material to protect the levees from overtopping.

inspection, maintenance, and fighting floods. Another example is human intervention, such as off-road vehicle use, which can reduce the integrity of the levee crown and/or slopes.

Penetrations

Penetrations of the levee, such as culverts, can directly contribute to flooding if the waterside opening does not have an appropriate closure device that seals the opening and prevents excessive seepage and subsequent instability of the levee. Because of unregulated historic construction, levees also contain many hidden risks that can cause internal erosion including: abandoned sluiceways, drainage pipes and cables, concrete loading docks, fuel tanks, and storage drums (Johnson and Pellerin 2010).

Burrowing Animals

The Delta provides an array of habitats, including marshlands, berms, and levees, for a variety of burrowing rodents. Burrows created by rodents, especially beavers, muskrats, and squirrels, can weaken the structural integrity of the levee and increase the likelihood of piping. Sunny-day levee failures may result from a combination of high tide and preexisting internal levee and foundation weaknesses that may or may not be caused by burrowing animals. Rodent activities and/or preexisting weaknesses in the levees and foundations are believed to have contributed considerably to past levee failures. Reclamation districts and levee maintenance districts routinely check levees for indications of wildlife that could cause levee damage and implement removal measures followed by levee repairs if necessary (FEMA 2005, pp. 64–70).

6.1.5 Delta Flood Risks

Federal Emergency Management Agency (FEMA) and DWR have developed analytical procedures to define the probability of flooding and assess the risk of levee failures caused by flooding, as described below.

6.1.5.1 FEMA Analyses

FEMA is a primary source of present flood risk information. A key element of the program uses Flood Insurance Studies to produce Flood Insurance Rate Maps (FIRMs). Risk of flooding is defined by the probability that a flood will occur in any given year. For example, the "100-year flood" is a flood that has a 1 percent chance of occurring in any given year. This is also referred to by FEMA as a 1 percent annual chance of flooding. Likewise, the "200-year flood" and "500 year flood" are floods that have a 0.5 percent and 0.2 percent chance, respectively, of occurring in any given year.

The FEMA flood map database is used to help establish the level of flood risk that exists at each community. FEMA's floodplains are delineated as follows:

- Special Flood Hazard Areas (SFHA): Areas that are subject to inundation by the 1 percent annual chance flood event.
- Other Flood Areas: Areas subject to inundation by the 0.2 percent annual chance flood or areas of 1 percent annual chance flood with average depths less than 1 foot or with drainage areas less than 1 square mile.
- Other Areas: Areas determined to be outside the 0.2 percent annual chance floodplain.

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FEMA does not delineate floodplains for floods smaller than 1 percent annual chance floods, meaning floods that occur more frequently, such as 2 and 10 percent annual chance (50 and 10 year) floods. The SFHAs shown on these maps include areas described as "A" zones. Zone A means that flood elevations have not been determined for the area. Areas not in the "A" zones generally are less likely to flood because of ground elevation or protection by a certified levee or other protective feature.

In 2003, FEMA initiated a nationwide FIRM Modernization Project (FEMA 2010a). This project includes a strict review of levees protecting low lying areas to ensure that they meet FEMA criteria for mapping a protected area as not being in a SFHA (i.e., not subject to inundation by a 1 percent annual chance flood).

Most areas of the Delta that were previously indicated as having 100 year protection (and therefore not included in SFHAs) are now having difficulty proving that their levees are adequate. Some areas, including West Sacramento and Reclamation District 17 in Lathrop, are initiating upgrade projects. Revised FEMA maps are planned to be issued over the next several years.

The Delta spans numerous FIRM panels and contains several FEMA flood zones. Encroachments within these flood zones are subject to Federal, State, and local regulatory requirements. The Federal regulatory requirements represent the minimum level of compliance needed. The local and State requirements may be more stringent. Existing FEMA flood zones within the Delta are broken into several groups: Special Flood Hazard Areas, Floodway Areas, Other Flood Areas, and Other Areas. The flood zones that exist within the Delta are described below.

- Special Flood Hazard Areas Special Flood Hazard Areas are subject to inundation by the 1 percent annual chance flood, or base flood. The following flood zones are Special Flood Hazard Areas that are present in the Delta:
  - Zone A refers to areas where the water surface elevations have not been determined for the base flood. No detailed studies were conducted for Zone A areas, and the boundaries are approximate. No floodways exist within Zone A boundaries. A significant portion of the Delta has been mapped as Zone A. The Zone A areas are primarily located near the boundaries of the legal limits of the Delta. The following RDs are mostly or entirely mapped as Zone A: 2068, 2104, 2060, 1667, 501, 1614, 828, 404, 2089, and 2117. A few small areas outside of these RDs are within the Delta boundaries and have been mapped as Zone A, as shown in Figure 6 9.
  - Zone AE characterizes Special Flood Hazard Areas where base floodwater surface elevations have been established. Floodway Areas in Zone AE are defined as the channel of a stream plus any adjacent floodplain areas. These areas must be kept free of encroachment so that the 1 percent annual chance flood can be carried without substantial increases in flood heights. A vast majority of the Delta is mapped as Zone AE. The areas mapped as Zone AE are primarily located in the central area of the Delta, but Zone AE areas encompass a greater part of all regions of the Delta. Virtually all of the primary zone of the Delta, with the exception of RDs 744, 755, 551, and 554, is mapped as Zone AE, as shown in Figure 6 9.
  - Zone AH represents Special Flood Hazard Areas where base flood elevations have been determined and the depth of water is between 1 and 3 feet. Only a small region of the Delta has been mapped as Zone AH. The zone covers the portion of the City of Thornton that is east of North Nowell Road, as shown in Figure 6 9. The City of Thornton is part of RD 348,

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which is located between the eastern boundary of the primary zone and the eastern legal limit of the Delta.

- Other Flood Areas Other Flood Areas are areas of 0.2 percent annual chance flood, areas of 1 percent annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, and areas protected by levees from the 1 percent annual chance flood:
  - Shaded Zone X areas represent the areas that fulfill the criteria in place for "Other Flood Areas." Generally, Shaded Zone X areas are those areas that are within the 0.2 percent annual chance floodplain, and either outside or protected from a 1 percent annual chance flood. This is shown on the FEMA flood zone map, shown in Figure 6 9 as "0.2 percent annual chance of flooding."
- Other Areas Other Areas consist of two flood zones: Un Shaded Zone X, Zone D, and Zone V/VE:
  - Un Shaded Zone X areas are those areas that are determined to be outside the 0.2 percent annual chance floodplain. A substantial portion of the Delta has been mapped as Un Shaded Zone X. Un Shaded Zone X areas include the following cities: Tracy in the southern Delta; Oakley, Antioch, and Pittsburg in the western Delta; and Stockton in the eastern Delta, as shown in Figure 6 9.
  - Zone D areas may contain flood hazards that have not been determined. These areas are located near Suisun Bay and Suisun Marsh, as shown in Figure 6 9.
  - Zone VE areas are coastal related flood zones that occur in Suisun Marsh, as shown in Figure 6 9.

6.1.5.2 FEMA Flood Areas

The following descriptions of communities in the Delta and Suisun Marsh area are based on existing FEMA maps, which show floodplain delineations for areas subject to 1 percent annual chance floods:

- Antioch. The City of Antioch is located within Contra Costa County and adjacent to the San Joaquin River. The City of Antioch is mapped into the 1 percent annual chance floodplain from the San Joaquin River and its tributaries (FEMA FIRM Maps 06013C: 0139F, 0143F, 0144F dated June 16, 2009).
- Benicia. The City of Benicia is located in Solano County and adjacent to the Suisun Bay. Flooding from the Suisun Bay accounts for a portion of the 1 percent annual chance floodplain (Zone AE) mapped in Benicia (FEMA FIRM Maps 06095C: 0635E, 0633E, 0634E, 0642E, 0653E, and 0675E dated June 16, 2009).
- Clarksburg. Clarksburg is an unincorporated community located on the western bank of the Sacramento River in Yolo County. Clarksburg does not have official boundaries, but it is situated to the north of the confluence of Elk Slough and the Sacramento River and south of Winchester Lake. Clarksburg is located within a 1 percent annual chance floodplain (Zone A). Levees are located along the Sacramento River and Elk Slough but not along Winchester Lake. These levees are shown as not providing protection from the 1 percent annual chance flood (FEMA FIRM Map 06113C0745G dated June 16, 2010).
- Courtland. Courtland is an unincorporated community located on the eastern bank of the Sacramento River in Sacramento County. Courtland is located in the Pierson District, which is bordered by the Sacramento River to the west and north, Snodgrass Slough to the east, and

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Meadows Slough to the south. Courtland is protected from the 1 percent annual chance flood by levees along the Sacramento River, Snodgrass Slough, and Meadows Slough, and is not mapped in a 1 percent annual chance floodplain (0602620005C dated September 30, 1988 and 0602620010D dated February 4, 1998).

- Lathrop. The City of Lathrop is divided by the San Joaquin River into two distinct land use sections: highly developed lands in the east and agricultural lands in the west. The area west of the San Joaquin River is subject to flooding by the 1 percent annual chance flood. However, the lands to the east are protected from the 1 percent annual chance flood by a levee along the eastern bank of the San Joaquin River, so this area is not mapped in a 1 percent annual chance floodplain. This levee is considered a Provisionally Accredited Levee (PAL), and levee owners or communities are required to submit the data necessary to comply with 44 CFR 65.10; otherwise, the levee can be de accredited (FEMA FIRM Maps: 06077C: 0585F, 0595F, 0605F, 0610F, 0615F, and 0610F dated October 16, 2009).
- Locke. Locke is an unincorporated community located on the eastern bank of the Sacramento River in Sacramento County. Locke does not have any official boundaries, but its general area is mapped in a 1 percent annual chance floodplain. Levees around Locke line the Sacramento River on the west, the Delta Cross Channel to the south, and Snodgrass Slough to the east, but do not protect it from the 1 percent annual chance flood (FEMA FIRM Map 0602620560C, dated September 30, 1988; Map 0602620420D, dated February 4, 1998).
- Manteca (western portion). The City of Manteca is located to southeast of the City of Lathrop adjacent to the San Joaquin River. A portion of Manteca is protected from the 1 percent annual chance flood (from the San Joaquin River) by the Western Ranch South Levee, which is considered a PAL (see discussion for Lathrop); this area is not mapped in 1 percent annual chance floodplain. South of the Western Ranch South Levee, a relatively small portion of the city is mapped in the 1 percent floodplain (FEMA FIRM Map 06077C0620F dated October 16, 2009).
- Oakley. The City of Oakley is located in Contra Costa County east of the City of Antioch and located adjacent to San Joaquin River, Big Break, and Dutch Slough. This city is mapped in the 1 percent annual chance floodplain from the San Joaquin River and its tributaries (FEMA FIRM Maps 06013C: 0165F, 0170F, 0355F, and 0360F dated June 16, 2009).
- Pittsburg. The City of Pittsburg is located in Contra Costa County and located adjacent to San Joaquin River and Suisun Bay. This city is mapped in the 1 percent annual chance floodplain from the Suisun Bay. Flooding sources also include the San Joaquin River (FEMA FIRM Maps 06013C: 0118F, 0119F, 0120F, and 0139F dated June 16, 2009).
- Rio Vista. The City of Rio Vista is drained east southeasterly by Marina Creek, Marina Creek Tributary, and Industrial Creek as they flow toward the Sacramento River. The portion of the city west of the Sacramento River is subject to the 1 percent annual chance flood (mapped in the 1 percent annual chance floodplain) because of flooding from the Watson Hollow and Cache Slough. The lower reaches of the Sacramento River are under the influence of tides. Severe flooding along this waterway could result when very high tides and a large volume of stream outflow occur coincidentally, and strong onshore winds generate wave action that would increase the flood hazard above that of the tidal surge alone (FEMA FIRM Maps 06095C: 0530E, 0424E, 0537E, 0541E, and 0539E dated May 4, 2009).
- Sacramento (Pocket Area). The City of Sacramento's Pocket Area is located in the southern portion of the community. This community is bordered by Interstate 5 to the east and the

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Sacramento River to the south, west, and north. A levee located along the Sacramento River is shown as providing protection from the 1 percent annual chance flood; however, this levee is shown as a PAL; this area is not mapped in the 1 percent annual chance floodplain (0602660285G and 0602660305G dated December 8, 2008).

- Stockton (western portion). The City of Stockton is situated adjacent to a network of sloughs and canals that branch off the San Joaquin River. The western region of Stockton is protected from the 1 percent annual chance flood by levees along Bear Creek, Lower Mosher Creek, Fourteen Mile Slough, Five Mile Slough, Disappointment Slough, Calaveras River, Smith Canal, Stockton Deep Water Ship Channel, Burns Cutoff, and the San Joaquin River. Each of these levees is considered a PAL (see discussion for Lathrop); this area is not mapped in a 1 percent annual chance floodplain (FEMA FIRM Maps: 06077C: 0295F, 02315F, 0320F, 0435F, 0455F, 0460F, 0465F, and 0470F dated October 16, 2009).
- Walnut Grove. Walnut Grove is an unincorporated community located on the eastern bank of the Sacramento River in the northern part of Tyler Island. It is protected from the 1 percent annual chance (100 year) flood by levees that line the Delta Cross Channel to the north and along the Mokelumne River to the south. This community is not mapped in a 1 percent annual chance floodplain.
- West Sacramento. The City of West Sacramento is currently designated as being protected from the 0.2 percent annual chance flood by levees that line the western bank of the Sacramento River (FEMA FIRM Maps 0607280005B and 0607280010B, dated January 19, 1995). However, FEMA is in the process of de accrediting the city's levees. The northeastern portion of the city is close to the confluence of the American and Sacramento rivers, which is a FEMA designated floodway. Levees are also located along the Yolo Bypass, Sacramento River Deep Water Ship Channel, and Sacramento Bypass.

FEMA maps indicate that much of the central Delta, essentially all of the non urban Delta, is within SFHAs (mapped in the 1 percent annual chance floodplain) and considered to be subject to inundation by the 1 percent annual chance flood. The urban areas at the edges of the Delta (West Sacramento, Sacramento, Stockton, Mossdale, etc.) are working to preserve their levee accreditation and thereby avoid being designated as "A" zones.

6.1.5.3 DWR State Plan of Flood Control

DWR recently completed a "Public Draft 2012 Central Valley Flood Protection Plan" (State Plan of Flood Control) (DWR 2011) for consideration by the Central Valley Flood Protection Board. The report analyzes current and future flood risks and recommends an investment approach to improve public safety, ecosystem conditions, and economic sustainability. The State Plan of Flood Control addresses the Sacramento River Flood Control Project facilities and other project levees to which DWR or the Central Valley Flood Protection Board cooperates with the federal government for operations and maintenance. The report included a summary of levee conditions for the levees evaluated in the report. The report indicated that about 50% of the 300 miles of urban levees evaluated do not meet engineering design criteria for projected design water surface elevations based on criteria published in "Design and Construction of Levees Engineering Manual 1110 2 1913" (USACE, 2000) and "Interim Levee Design Criteria for Urban and Urbanizing Areas in the Sacramento Valley, Version 4" (DWR 2010c). The report also indicated that about 60% of the 1,230 miles of non urban levees considered have a high potential for failure for projected design water surface elevations based upon an analysis that correlated geotechnical data with levee performance

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history but not relative to specific design criteria. The report further described that about 50% of the 1,016 miles of channels evaluated had potentially inadequate capacity to convey design flows; none of the 32 hydraulic structures and 11 pumping plants inspected were rated "unacceptable," many were approaching the end of their design life; and 2 of the 10 bridges that were inspected required repairs (DWR 2011). This analysis only applies to the Project Levees in the Delta.

6.2 Regulatory Setting

This section provides the regulatory setting for surface water resources, including potentially relevant federal, state, and local requirements applicable to the BDCP.

Federal regulations that address water quality also may apply to surface water quality, as presented in Chapter 8, Water Quality, and Chapter 10, Soils. These regulations are federally mandated and implemented in California through the State Water Resources Control Board. State regulations that address water quality also may apply to surface water quality, including the and Order No. 99 08 DWQ, NPDES General Permit No. CAS000002, WDRs for Discharges of Stormwater Runoff Associated with Construction Permit (General Permit) as presented in Chapter 8, Water Quality, and Chapter 10, Soils.

6.2.1 Federal Plans, Policies, and Regulations

The following Federal regulations may apply to surface water, but are presented in other sections:

- Safe Drinking Water Act (42 USC 300f) – see Chapter 8, Water Quality
- Clean Water Act (33 USC 1251–1376) – see Chapter 8, Water Quality and Chapter 9, Soils.
- Central Valley Project Improvement Act (PL 102 575) see Chapter 5, Water Supply.
- Coordinated Operations Agreement – see Chapter 5, Water Supply.
- Trinity River Mainstem Fishery Restoration (per Central Valley Project Improvement Act) – see Chapter 5, Water Supply.
- San Joaquin River Agreement – see Chapter 5, Water Supply.
- National Marine Fisheries Service and U.S. Fish and Wildlife Service Biological Opinions – see Chapter 5, Water Supply.
- Federal Power Act – see Chapter 5, Water Supply.

Other Federal plans, policies, and regulations that could affect surface waters are related to management of floodplains.

6.2.1.1 1850 Swamp and Overflowed Lands Act

In 1849, Congress granted Louisiana certain wetlands described as "swamp and overflowed lands, which may be or are found unfit for cultivation" in order to facilitate land reclamation and the control of flooding. On September 28, 1850, Congress passed a subsequent Swamp and Overflowed Lands Act to convey similar public lands to twelve other states with no cost. This act, sometimes referred to as the Arkansas Act, also applied to California. The only requirement of the act was that the states use the funds they realized from the sale of these lands to ensure that they would be

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drained, reclaimed, and put to productive agricultural uses. The State of California received 2,192,506 acres of land, which included 549,540 acres in the Sacramento Valley and approximately 500,000 acres in the Sacramento San Joaquin Delta.

6.2.1.2 Federal Emergency Management Agency

FEMA is responsible for maintaining minimum Federal standards for floodplain management within the United States and territories of the United States. As discussed below, FEMA plays a major role in managing and regulating floodplains. FEMA is responsible for management of floodplain areas, which are defined as the lowland and relatively flat areas adjoining inland and coastal waters subject to a 1 percent or greater chance of flooding in any given year (the 100 year floodplain).

Executive Order 11988, Floodplain Management

Under Executive Order 11988, all Federal agencies are charged with floodplain management responsibilities when planning or designing Federally funded projects or when considering any permit applications for which a Federal agency has review and approval authority. These responsibilities include taking action to reduce the risks of flood losses, including adverse impacts to human safety, health, and welfare. Federal agencies also are charged with the responsibility of restoring the natural and beneficial values of floodplains. If a proposed action is located within a floodplain, measures should be identified to minimize flood hazards, and floodplain mitigation requirements should be incorporated into the proposed action (FEMA 1982).

National Flood Insurance Program

FEMA administers the National Flood Insurance Program (NFIP). The NFIP has two main components: floodplain management assistance and flood insurance assistance. The purpose of flood insurance is to enable property owners to purchase insurance against losses from physical damage or the loss of buildings and their contents caused by floods, flood related mudslides, or erosion. Insurance is available to property owners belonging to NFIP participating communities. The NFIP is administered by the Federal Insurance Administration under FEMA. Participation in the NFIP also makes communities eligible for Federal flood disaster assistance. For a community to be eligible to participate in the NFIP, the community must adopt a local floodplain management ordinance that meets or exceeds the minimum Federal standards defined in 44 CFR 60–65. Participating communities must adhere to all floodplain management requirements, with oversight from FEMA, for all activities that may affect floodplains within the Special Flood Hazard Areas.

As part of the NFIP, FEMA provides one or more FIRMs (discussed previously in the Floodplain Delineation section). Each FIRM contains flood zones that are used to determine a community's flood insurance rates and floodplain development restrictions. It identifies which communities are Federally required to carry flood insurance. For example, communities can choose to participate or not participate in the NFIP. Homeowners with Federally backed mortgages may be required to carry flood insurance, but otherwise may not be required to carry insurance. Flood zones are areas delineated to represent areas with similar flood risk, flood protection infrastructure, flood protection infrastructure certifications, and designated floodways. FEMA requires that local governments covered by Federal flood insurance pass and enforce a floodplain management ordinance that specifies minimum requirements for any construction within the 100 year floodplain.

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Flood Zone Regulations

Special Flood Hazard Areas are subject to Federal and State requirements, which are defined primarily by federal regulations at 44 CFR 60.3 and 44 CFR 65.12. The first citation requires the following:

> (6) Notify, in riverine situations, adjacent communities and the State Coordinating Office prior to any alteration or relocation of a watercourse, and submit copies of such notifications to the Administrator;
>
> (7) Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained;
>
> (10) Require until a regulatory floodway is designated, that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zones A1–30 and AE on the community's FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community [44 CFR 60.3(b)(6,7,10)].

These Federal regulations are intended to address the need for effective floodplain management and provide assurance that the cumulative effects of floodplain encroachment do not cause more than a 1 foot rise in water surface elevation after the floodplain has been identified on the FIRM (local flood ordinances can set a more stringent standard). The absence of a detailed study or floodway delineation places the burden on the project proponent to perform an appropriate engineering analysis to prepare hydrologic and hydraulic analyses consistent with FEMA standards. These analyses would then be used to evaluate the proposed project together "with all other existing and anticipated development." Defining future anticipated development is difficult. The purpose of this requirement is to avoid inequitable encroachments into the floodplain.

For projects that are discovered to cause any increase in water surface elevations, 44 CFR 65.12, "Revision of flood insurance rate maps to reflect base flood elevations caused by proposed encroachments," states:

> (a) When a community proposes to permit encroachments upon the flood plain when a regulatory floodway has not been adopted or to permit encroachments upon an adopted regulatory floodway which will cause base flood elevation increases in excess of those permitted under paragraphs (c)(10) or (d)(3) of § 60.3 of this subchapter, the community shall apply to the Administrator for conditional approval of such action prior to permitting the encroachments to occur and shall submit the following as part of its application:
>
> (1) A for conditional approval of map change and the appropriate initial fee as specified by § 72.3 of this subchapter or a request for exemption from fees as specified by § 72.5 of this subchapter, whichever is appropriate;
>
> (2) An evaluation of alternatives which would not result in a base flood elevation increase above that permitted under paragraphs (c)(10) or (d)(3) of § 60.3 of this subchapter demonstrating why these alternatives are not feasible;
>
> (3) Documentation of individual legal notice to all impacted property owners within and outside of the community, explaining the impact of the proposed action on their property;
>
> (4) Concurrence of the Chief Executive Officer of any other communities impacted by the proposed actions;
>
> (5) Certification that no structures are located in areas which would be impacted by the increased base flood elevation;

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(6) A request for revision of base flood elevation determination according to the provisions of § 65.6 of this part;

(7) A request for request floodway revision in accordance with the provisions of § 65.7 of this part.

The provisions of this regulation require either demonstration that the proposed project would cause no effect on the base flood elevations or else the project must obtain a Conditional Letter of Map Revision prior to permitting the project for construction. Also, as suggested, if the project causes no effect on the base flood elevations, it can be approved by the floodplain administrator for the community without any approvals by FEMA or Conditional Letter of Map Revision submittals to FEMA. However, the floodplain administrator can require a Conditional Letter of Map Revision if it is felt that the project is of sufficient complexity to warrant FEMA's review.

The minimum Federal regulatory requirement pertaining to encroachments into the floodway is defined by 44 CFR 60.3(d)(3):

(3) Prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge.

This regulation applies only to encroachments into the floodway. When there is such an encroachment, the FEMA effective hydraulic model should be used to evaluate the impacts and mitigation options for the encroachment.

FEMA Levee Design and Maintenance Regulations

Code of Federal Regulations

Guidance and criteria for levees included in the NFIP are provided in 44 CFR 65.10. The major criteria within the document include freeboard, closure structures, embankment protection, embankment and foundation stability, settlement, interior drainage, and other design criteria. Operation and maintenance requirements are also discussed. Each of these criteria includes specific design guidelines that must be met in order for the levee to remain in the NFIP. It should be noted that FEMA is not responsible for evaluating these levees; the evaluation is performed by others, which leads to FEMA accreditation when FEMA adopts the certification.

Procedure Memorandum 34

Procedural Memoranda supplement and clarify the information in Appendix H of FEMA's Guidelines and Specifications for Flood Hazard Mapping Partners (2003) regarding mapping the base flood in areas with levees. Procedural Memorandum 34, Interim Guidance for Studies Including Levees, provides FEMA staff, contractors, and mapping partners with guidance for the evaluation and mapping of levees and levee affected areas as part of the FEMA Flood Map Modernization Program (FEMA 2010b).

Procedure Memorandum 43

Procedural Memorandum 43, Guidelines for Identifying Provisionally Accredited Levees, provides FEMA staff, contractors, and mapping partners with guidance for identifying Provisionally

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Accredited Levees and mapping levee affected areas. Also included is a fact sheet, prepared in question and answer format, that provides detailed information regarding NFIP procedures for evaluating and mapping levee systems with emphasis on Procedural Memorandum 43 and Provisionally Accredited Levee systems. This fact sheet was designed for a more technical audience. Additional documents include flow charts and sample letters for different levee scenarios (National Committee on Levee Safety 2009).

Hazard Mitigation Plan Criteria

Guidance regarding Hazard Mitigation Plans for both State and local agencies is provided in 44 CFR 201. Hazard Mitigation Plans are necessary for receiving grant funding under the Stafford Act for prevention planning. The States must demonstrate a commitment to risk reduction from natural hazards, including levee failure. Hazard Mitigation Plans act as guidance for State decision makers in determining the appropriation of resources to the reduction of these risks.

In California, the Hazard Mitigation Plan design standards (based upon geometric criteria for the levees) were negotiated by the FEMA, DWR, California Office of Emergency Services, and the Delta Levee Maintaining Agencies between 1983 and 1987 to establish a minimal, short term interim standard to reduce the risk of repeat flood damage. Although this standard was to be an interim standard, no adjustments based on subsequent or projected flood elevations have been used to modify the standard. Meeting this standard allows the Delta island or tract to be eligible for FEMA disaster grants and assistance following levee failures and island inundation. If even a portion of the levee around the island or tract does not meet the Hazard Mitigation Plan standard, the FEMA will deny claims for levee damage.

FEMA 100 year (Base Flood) Protection

The FEMA 100 year Protection standard, often called the 1 percent annual chance flood level of protection, is based on criteria established in the Code of Federal Regulations and is often used with established USACE criteria to meet certain freeboard, slope stability, seepage/underseepage, erosion, and settlement requirements. Numerical hydrologic models are used to project surface water elevations at different locations in the rivers for the statistically probable 100 year flood event. Model runs are updated periodically to reflect changes in river bathymetry and historical hydrology. Meeting this level of flood protection means that communities will not require mandatory purchase of flood insurance for houses in the floodplain or be subject to building restrictions. This standard generally does not address seismic stability. Currently, FEMA 100 year criteria are based on historical conditions and do not include considerations for climate change or sea level rise. FEMA is currently completing a study on the Impact of Climate Change on the National Flood Insurance Program (FEMA 2010c) to determine how to accommodate these factors and the long term implications.

FEMA Levee Design and Maintenance Requirements

For levees to be accredited by FEMA, and to allow communities to participate in Preferred Risk programs of the NFIP, evidence must be provided that adequate design, operation, and maintenance systems are in place to provide reasonable assurance that protection from the base flood (1 percent annual chance of exceedance or 100 year flood) exists. These requirements are outlined in 44 CFR, Volume 1, Chapter I, Part 65.10 and summarized as follows:

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- Freeboard. Riverine levees must provide a minimum freeboard of 3 feet above the water surface level of the base flood. An additional 1 foot above the minimum is required within 100 feet on either side of structures (such as bridges) riverward of the levee or whatever the flow is constructed. An additional 0.5 foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.
- Closure. All openings must be provided with closure devices that are structural parts of the system during operation and designed according to sound engineering practice.
- Embankment protection. Engineering analyses must be submitted demonstrating that no appreciable erosion of the levee embankment can be expected during the base flood as a result of either currents or waves, and that anticipated erosions will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability.
- Embankment and foundation stability. Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability.
- Settlement. Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be maintained within the minimum standards.
- Interior drainage. Analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than 1 foot, the water surface elevation(s) of the base flood.
- Operation plans. For a levee system to be recognized, a formal plan of operation must be provided to FEMA. All closure devices or mechanical systems for internal drainage, whether manual or automatic, must be operated in accordance with an officially adopted operational manual, a copy of which must be provided to FEMA.
- Maintenance Plans. Levee systems must be maintained according to an officially adopted maintenance plan. All maintenance activities must be under the jurisdiction of a federal or State agency, an agency created by the federal or State law, or an agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance. The plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and system are maintained. At a minimum, maintenance plans shall specify the maintenance activities to be performed, the frequency of their performance, and the person, by name or by title, responsible for their performance.

The information submitted to support that the levee complies with the above requirements must be certified by a registered professional engineer. Certified as built plans of the levee also must be submitted.

6.2.1.3 U.S. Army Corps of Engineers

The following discussion provides an overview of USACE's regulatory responsibilities that apply to navigable waters and construction within the ordinary high water mark of other waters of the United States. In addition, USACE constructs flood control and risk management projects and

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monitors their operations and maintenance. It also provides emergency response to floods. These functions are also described below.

Flood Control Act of 1936

USACE constructs local flood control and risk management projects and navigation projects in the Delta. The Flood Control Act of 1936 established a nationwide policy that flood control on navigable waters or their tributaries is in the interest of the general public welfare and is, therefore, a proper activity of the Federal government in cooperation with States and local entities. The 1936 Act, its amendments, and subsequent legislation specify details of Federal participation. Projects are either specifically authorized through legislation by Congress or through a small projects blanket authority. Typically, a feasibility study is done to determine Federal interest before authorization or construction. USACE has a Delta feasibility study underway. A study under the American River Common Features authority is studying additional flood protection for the City of Sacramento that could involve alteration to Sacramento River levees or the Yolo Bypass in the Delta. The planned San Joaquin River basin study will evaluate more flood protection for the City of Stockton and vicinity. The West Sacramento Feasibility Study is evaluating flood protection for the City of West Sacramento.

U.S. Army Corps of Engineers Navigation Projects

Federal interest in navigation is established by the Commerce Clause of the Constitution and court decisions defining the right to improve and protect navigable waterways in the public's interest. USACE navigation projects in the Delta include Suisun Bay Channel, Sacramento River Deep Water Ship Channel, and Stockton Deep Water Ship Channel. Associated with navigation is the Long Term Management Strategy for Delta Sediments. This is a plan to coordinate and manage dredging for navigation, flood risk management, water conveyance, and recreation; stabilize levees; and protect ecosystems. Technical work groups are engaged in pilot studies, preparing orders and permits for dredging and beneficial reuse and compliance with environmental laws. The Suisun Channel in the Suisun Marsh is a USACE navigation project to maintain a navigable connection between the City of Suisun and Grizzly Bay (USACE 2006; USACE Website 2010).

U.S. Army Corps of Engineers Responsibility Under Clean Water Act

The Clean Water Act established the basic structure for regulating discharges of pollutants into waters of the United States and gave the U.S. Environmental Protection Agency the authority to implement pollution control programs such as setting wastewater standards for industry. The Clean Water Act sets water quality standards for all contaminants in surface waters and allows the U.S. Environmental Protection Agency to delegate some of its authority for enforcing such standards to states (the California State Water Resources Control Board is the agency that helps enforce water quality standards in California). The law employs a variety of regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff.

Section 404 of the Clean Water Act establishes programs to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. Activities in waters of the United States that are regulated under this program include fills for development, water resource projects (e.g., dams and levees), infrastructure development (e.g., highways and airports), and conversion of wetlands to uplands for farming and forestry. Under Section 404, any person or public agency

Number: 1 Author: L2EDEEAK Subject: Sticky Note Date: 4/17/2012 10:30:03 AM

The USACE also has a shallow draft navigation responsibility on the Sacramento and Feather Rivers. Contact Gary Kamei at (916) 557-6845 for more details.

Number: 2 Author: L2EDEEAK Subject: Sticky Note Date: 4/17/2012 10:32:23 AM

The USACE is also engaged in design and construction of South Sacramento Streams which is also partially in the Legal Delta boundary. Contact Marshall Marik at (916)557-7698 for more details.

proposing to locate a structure, excavate, or discharge dredged or fill material into waters of the United States or to transport dredged material for the purpose of dumping it into ocean waters must obtain a permit from USACE. USACE has jurisdiction over all waters of the United States including, but not limited to, perennial and intermittent streams, lakes, ponds, as well as wetlands in marshes, wet meadows, and side hill seeps. Clean Water Act Section 404(b)(1) guidelines provide environmental criteria and other guidance used in evaluating proposed discharges of dredged materials into waters of the United States. For proposed discharges of dredged material to comply with the guidelines, they must satisfy four requirements found in Section 230.10. Among these requirements are that those discharges of dredged material do not result in significant degradation of the aquatic ecosystem and that all practicable means be used to minimize adverse environmental impacts.

Under Section 401 of the Clean Water Act, every applicant for a Federal permit or license for any activity that may result in a discharge to a water body must obtain State certification that the proposed activity will comply with State water quality standards (City of Stockton 2005).

Rivers and Harbors Act of 1899

33 United States Code 408 and Section 14 of the Rivers and Harbors Act of 1899 (RHA) provide that the Secretary of the Army, on the recommendation of the Chief of Engineers, may grant permission for the temporary occupation or use of any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States. This permission will be granted by an appropriate real estate instrument in accordance with existing real estate regulations. This regulation is used to require permits prior to modifications of Federal project levees. Types of alterations typically requiring a Section 408 permit are major modifications such as degradations, raisings, and realignments.

Sections 9 and 10 of RHA authorize USACE to regulate the construction of any structure or work within navigable waters. The RHA authorizes USACE to regulate the construction of infrastructure such as wharves, breakwaters, or jetties; bank protection or stabilization projects; permanent mooring structures, vessels, or marinas; intake or outfall pipes; canals; boat ramps; aids to navigation; or other modifications affecting the course, location condition, or capacity of navigable waters. USACE's jurisdiction under RHA is limited to "navigable water," or waters subject to the ebb and flow of the tide shoreward to the mean high water mark that may be used to transport interstate or foreign commerce. USACE must consider the following criteria when evaluating projects within navigable waters: (1) the public and private need for the activity; (2) reasonable alternative locations and methods; and (3) beneficial and detrimental effects on the public and private uses to which the area is suited (City of Stockton 2005).

Emergency Flood Control Funds Act of 1955

In addition to regulatory activities, USACE has a number of projects and functions that can potentially affect activities in the Delta. The Emergency Flood Control Fund Act, Public Law 84-99, authorizes emergency funding and response for levee repairs and flood preparation. USACE can provide flood fighting readiness within hours; however, this action is supplemental to services provided by local reclamation districts and State agencies. USACE and DWR have a working relationship through a memorandum of understanding originally drafted in 1955 and amended since then (USACE 2005).

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USACE Delta Levee Funding

The Water Supply, Reliability, and Environmental Improvement Act of 2004 (Public Law 108-361) authorizes the USACE to design and construct levee stability projects for purposes such as flood damage reduction, ecosystem restoration, water supply, water conveyance, and water quality objectives as outlined in the CALFED Bay-Delta Program, Programmatic ROD (CALFED 2000c). Furthermore, section 103(f)(3)(B) of this Act authorizes the USACE to undertake the eight following activities:

- Reconstruct Delta levees to a base level of protection (also known as the "Public Law 84-99 standard")
- Enhance the stability of levees that have particular importance in the system through the Delta Levee Special Improvement Projects Program
- Develop best management practices to control and reverse land subsidence on Delta islands
- Develop a Delta Levee Emergency Management and Response Plan that will enhance the ability of federal, State, and local agencies to rapidly respond to levee emergencies
- Develop a Delta Risk Management Strategy after assessing the consequences of Delta levee failure from floods, seepage, subsidence, and earthquakes
- Reconstruct Delta levees using, to the maximum extent practicable, dredged materials from the Sacramento River, the San Joaquin River, and the San Francisco Bay
- Coordinate Delta levee projects with flood management, ecosystem restoration, and levee protection projects of the lower San Joaquin River and lower Mokelumne River floodway improvements and other projects under the Sacramento-San Joaquin Comprehensive Study
- Evaluate and, if appropriate, rehabilitate the Suisun Marsh levees

The Act directed the USACE to identify and prioritize levee stability projects that could be carried out with federal funds. An initial amount of $90 million was authorized, with another $106 million authorized in the 2007 Water Resources Development Act of 2007 (WRDA). The USACE initially solicited proposals for various levee improvement projects and received 68 project proposals totaling more than $1 billion. In the short-term, the USACE plans to proceed with implementation of high-priority improvements that can be constructed with the limited funds appropriated to date.

The USACE also is proceeding with a Delta Islands and Levees Feasibility Study to develop long-term plans for flood-risk management, water quality, water supply, and ecosystem restoration. In addition, the USACE is working on a Lower San Joaquin Feasibility Study to determine whether there is a federal interest in providing flood risk management and ecosystem restoration on the lower San Joaquin River.

Water Resources Development Act of 2007

The Water Resources Development Act of 2007, or Public Law 110-114, includes the National Levee Safety Act of 2007 (Title IX), which established the National Levee Safety Committee. This also authorized a report to Congress summarizing the condition of levees in the United States, including both Federal and non-Federal levees.

The Water Resources Development Act amended the authority granted to the USACE under PL 108-361. The USACE issued guidance for the implementation of the supplemental authority granted

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under section 3015 of Water Resources Development Act. This guidance was issued through a CECW-PB Memorandum dated 11 August 2008 titled, "Implementation Guidance for the Water Resources Development Act of 2007 (WRDA 2007)—Section 3015, CALFED Levee Stability."

Operations and Maintenance Controls, Flood Control Projects

The maintenance and operation of Federal project levee structures is discussed in 33 CFR 208.10. According to these regulations, no improvement shall be passed over, under, or through the walls, levees, improved channels, or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the Department of the Army or his or her authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the function of the protective facilities. This regulation is the basis for requiring a permit prior to any construction at Federal project levees. Types of alterations/modifications typically covered by a 208 permit include bridges, pump houses, stairs, pipes, bike trails, and power poles.

USACE Rehabilitation and Inspection Program

The Rehabilitation and Inspection Program is the USACE program that provides for the inspection of flood-control projects, the rehabilitation of damaged flood-control projects, and the rehabilitation of federally authorized and constructed hurricane or shore-protection projects. Levees in the program are eligible for federally funded repair and rehabilitation for damage induced by flood events, provided funding is available. The project levees in the Delta, those levees previously authorized or constructed under a federal flood-control project, are eligible for the program as long as the non-federal sponsor maintains the levees to certain federal standards. Repairs and rehabilitation are accomplished under provisions of Public Law 84-99, with some cost-sharing normally required for nonproject levees. Nonproject levees are managed and maintained by local districts, as opposed to project levees, which are part of a larger regional or State project, and managed and maintained by a federal or State agency.

For nonproject levees in the Delta to be eligible, the local maintaining agency must first apply for participation into the program. To be admitted, the levees must meet certain requirements, and be maintained to federal levee standards, and pass a rigorous initial inspection. They must also pass subsequent routine inspections to remain in the program. Very few levees in the central Delta meet these standards or pass the initial inspections. Remaining in the program will be more challenging in the future, even for project levees, because the USACE has begun enforcing more stringent vegetation standards that call for no woody vegetation on levees or within 15 feet of levees. These standards may also affect the design of habitat restoration projects on the water side of existing levees.

The Public Law 84-99 standard is a minimum requirement for all federal flood control project levees, such as the Sacramento or San Joaquin River Flood Control Projects. The standard was developed for major rivers, such as the Mississippi River, and was not necessarily appropriate for the non-federal flood control project levees. In 1987, USACE developed a Delta-specific standard based on the Delta organic soils and levee foundation conditions. Compliance with this standard allows for USACE emergency assistance for levee rehabilitation and island restoration following levee failures and island inundation, provided the reclamation district applies for and is accepted into the program and passes a rigorous initial inspection and periodic follow-up inspections.

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6.2.1.4 U.S. Bureau of Reclamation

Reclamation owns and manages several dams and distribution canals upstream of and within the Delta. Its upstream reservoirs and dams include such major facilities as Shasta, Folsom, New Melones, and Friant dams. These multipurpose facilities regulate flows to the Delta and provide water supply, hydroelectric, flood control, recreation, and other benefits. Reclamation consults with the State and provides technical assistance related to reservoir reoperation studies. Reservoir operations are covered in Chapter 5, Water Supply.

6.2.1.5 Other Federal Agencies

Other federal agencies have programs related to floodplain management. These include USGS and the Natural Resources Conservation Service (DWR 1997).

USGS, in cooperation with DWR, is responsible for collecting surface water data, which becomes the primary database used to develop the hydrologic information required for defining hydraulic studies.

The Natural Resources Conservation Service is involved in watershed planning. It has programs that can provide assistance to local governments and the State in constructing flood relief facilities and preventing flood damage.

6.2.1.6 CALFED Bay Delta Program Levee System Integrity Program

The CALFED Bay Delta Program's Levee System Integrity Program is a federal and state program that provides maintenance and improvement work to the Delta levee system. Goals and objectives of the program include:

- Base Level Protection – This program provides funding to help local reclamation districts reconstruct Delta levees to a base level of protection (Public Law 84 99).
- Special Improvement Projects – This program is intended to enhance levee stability for particularly important levees. Priorities include protection of life, personal property, water quality, the Delta ecosystem, and agricultural production.
- Suisun Marsh Protection and Ecosystem Enhancement – This program provides levee integrity, ecosystem restoration, and water quality benefits by supporting maintenance and improvement of the levee system in the Suisun Marsh.
- Levee Emergency Response Plan – This program is intended to enhance agency and local efforts to respond to levee emergencies.

6.2.2 State Plans, Policies, and Regulations

State plans, policies, and regulations related to surface water address water rights issues and flood management issues. Regulations that address water quality are described in Chapter 8, Water Quality.

6.2.2.1 California Water Rights

In California, both the riparian doctrine and the prior appropriation doctrine apply (dual system). Riparian rights result from the ownership of land bordering a surface water source and are normally

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senior in priority to most appropriative rights. Owners with riparian water rights may use natural flows directly for beneficial purposes on adjoining lands without a permit from the State Water Resources Control Board (State Water Board).

Appropriative rights are obtained by diverting surface water and applying it to a beneficial use. Before 1914, appropriative rights could be obtained by diverting an using the water, posting a notice of appropriation at the point of diversion, and recording a copy of the notice with the county recorder. Since 1914, the acquisition of an appropriative right requires a permit from the State Water Board.

The State Water Board is responsible for overseeing the water rights and water quality functions in California. It has jurisdiction to issue permits and licenses for appropriation from surface and underground streams; whereas the California courts generally have jurisdiction over the use of infiltrating groundwater, riparian use of surface waters, and the appropriative use of surface waters from diversions begun before 1914.

6.2.2.2 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne Act) established the State Water Board and the Regional Water Quality Control Boards (RWQCBs) as the principal State agencies with primary responsibility for the coordination and control of water quality (Water Code section 13001), including the enforcement of applicable laws and regulations. The State Water Board is responsible for allocating surface water rights (SWRCB 2011).

Under the Porter-Cologne Act, waters of the State fall under jurisdiction of the State Water Board and the nine RWQCBs. "Waters of the State" are any surface or groundwater body within the boundaries of the State (Water Code section 13050(e)). The State Water Board and the RWQCBs also have delegated federal authority to implement the requirements of the federal Clean Water Act in California, which is largely done through the implementation of the Porter-Cologne Act.

Under the Porter-Cologne Act, the RWQCBs must prepare and periodically update water quality control plans, also known as basin plans. Each basin plan sets forth water quality objectives sufficient to ensure reasonable protection of designated beneficial uses of surface water and groundwater, as well as actions to control nonpoint and point sources of pollution. Any person who discharges or proposes to discharge any waste that could affect the quality of the waters of the State must file a "report of waste discharge" with the appropriate RWQCBs "Waste" includes any and all waste substances associated with human habitation, of human or animal origin, or from any producing, manufacturing or processing operation (Water Code section 13050(d)). Upon receipt of a report of waste discharge, the RWQCBs may then issue "waste discharge requirements" designed to ensure compliance with applicable water quality objectives and other requirements of the Basin Plan.

6.2.2.3 1995 Water Quality Control Plan and Water Rights Decision D-1641

The 1995 WQCP was developed as a result of the 1994 Bay-Delta Accord, which committed the CVP and SWP to new Delta habitat objectives. The new objectives were adopted through a Water Rights Decision D-1641 for CVP and SWP operations. One of the main features of the 1995 Water Quality Control Plan was the estuarine habitat objectives ("X2") for Suisun Bay and the western Delta. The X2 standard refers to the position at which 2 parts per thousand salinity occurs in the Delta estuary, and is designed to improve shallow water fish habitat in the spring of each year. Other elements of

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the 1995 Water Quality Control Plan include export to inflow ratios intended to reduce entrainment of fish at the export pumps, Delta Cross Channel gate closures, minimum Delta outflow requirements, and San Joaquin River salinity and flow standards.

6.2.2.4 Suisun Marsh Preservation Agreement

On March 2, 1987, the Suisun Marsh Preservation Agreement was signed by DWR, DFG, Reclamation, and the Suisun Resource Conservation District. The purpose of the agreement was to establish mitigation for impacts on salinity from the SWP, CVP, and other upstream diversions. The Suisun Marsh Preservation Agreement has the following objectives:

- To ensure that Reclamation and DWR maintain a water supply of adequate quantity and quality to manage wetlands in the Suisun Marsh (to mitigate adverse effects on these wetlands from SWP and CVP operations, as well as a portion of the adverse effects of other upstream diversions)
- To improve Suisun Marsh wildlife habitat on these managed wetlands
- To define the obligations of Reclamation and DWR necessary to ensure the water supply, distribution, management facilities, and actions necessary to accomplish these objectives
- To recognize that water users in the Suisun Marsh (i.e., existing landowners) divert water for wildlife habitat management in the Suisun Marsh

In 2000, the CALFED ROD was signed, which included the Environmental Restoration Program (ERP) calling for the restoration of 5,000 to 7,000 acres of tidal wetlands and the enhancement of 40,000 to 50,000 acres of managed wetlands (CALFED 2000b). In 2001, the U.S. Fish and Wildlife Service, federal Bureau of Reclamation, Department of Fish and Game (DFG), DWR, National Marine Fisheries Service, Suisun Resource Conservation District, and CALFED Bay Delta Program (the Principal Agencies) directed the formation of a charter group to develop a plan for Suisun Marsh that would balance the needs of CALFED, the Suisun Marsh Preservation Agreement, and other plans by protecting and enhancing existing land uses, existing waterfowl and wildlife values including those associated with the Pacific Flyway, endangered species, and State and Federal water project supply quality. In addition to the Principal Agencies, the charter group includes other regulatory agencies such as USACE, Bay Conservation and Development Commission, State Water Board, and RWQCBs.

In 2011, the Principal Agencies completed a Final EIS/EIR (Reclamation 2011) that describes three alternative 30 year plans and their potential impacts. The adopted alternative will become the Suisun Habitat Management, Preservation, and Restoration Plan. The plan purposes/objectives to implement the CALFED ROD Preferred Alternative of restoration of 5,000 to 7,000 acres of tidal marsh and protection and enhancement of 40,000 to 50,000 acres of managed wetlands; maintain the heritage of waterfowl hunting and other recreational opportunities and increase the surrounding communities' awareness of the ecological values of Suisun Marsh; maintain and improve the Suisun Marsh levee system integrity to protect property, infrastructure, and wildlife habitats from catastrophic flooding; and protect and, where possible, improve water quality for beneficial uses in Suisun Marsh.

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6.2.2.5 Department of Water Resources

DWR's mission is to manage the State's water resources, in cooperation with other agencies, to benefit the public and to protect, restore, and enhance the natural and human environments. Within this mission, DWR's goal, as related to flood, is to "protect public health, life, and property by regulating the safety of dams, providing flood protection, and responding to emergencies." DWR meets these responsibilities through the following activities (DWR Web site and Water Code section 6000):

- Supervising design, construction, enlargement, alteration, removal, operation, and maintenance of more than 1,200 jurisdictional dams
- Encouraging preventive floodplain management practices; regulating activities along Central Valley floodways
- Maintaining and operating specified Central Valley flood control facilities
- Cooperating in flood control planning and facility development
- Maintaining the State Federal Flood Operations Center and the Eureka Flood Center to provide flood advisory information to other agencies and the public
- Cooperating and coordinating in flood emergency activities and other emergencies
- DWR also owns and operates the State Water Project (SWP), with numerous water storage and conveyance facilities throughout the state. DWR exports water from the Delta at its North Bay Pumping Plant at Barker Slough and at the Harvey O. Banks Pumping Plant in the south Delta.

State Delta Levees Maintenance Subvention Program

The Delta Levees Maintenance Subvention Program is a State cost sharing program in which participating local levee maintenance agencies receive funds for the maintenance and rehabilitation of nonproject levees in the Delta. The program's goal is "to reduce the risk to land use associated with economic activities, water supply, infrastructure, and ecosystem from catastrophic breaching of Delta levees by building all Delta levees to the Bulletin 192 82 Standard" (DWR 1995). There is a statewide interest in levee maintenance in the Delta because the islands levees maintain flow velocities in the sloughs and channels that combat saltwater intrusion. The program is authorized in the Water Code, sections 12980–12995. In 1988, with the passage of the Delta Flood Protection Act, financial assistance for several communities maintaining local Delta levees was increased through the Delta Levees Subvention Program. The intent of the program is given in Water Code article 12981 and states that the key to preserving the Delta physical characteristics is the system of levees defining the waterways and producing the adjacent islands Thus, funds necessary to maintain and improve the Delta's levees to protect the physical characteristics should be used.

Delta Levees Special Flood Projects Program

The Delta Levees Special Flood Control Projects (Special Projects) provides financial assistance to local levee maintaining agencies for levee rehabilitation in the Delta. The program was established by the California Legislature under SB 34 in 1988. Since the inception of the program, more than $200 million has been provided to local agencies in the Delta for flood control and related habitat projects. For example, some levees were raised above the 1 percent annual chance water surface elevations, such as on Webb Tract, Bouldin Island, Empire Tract, King Island, Ringe Tract, and Canal Ranch (California Central Valley Flood Control Association 2011).

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6.2.2.6 Assembly Bill 1200

Assembly Bill 1200 (Laird 2005) highlighted the complex water issues in the Delta and directed DWR and DFG to report to the Legislature and Governor on the following:

- Potential impacts of levee failures on water supplies derived from the Delta because of future subsidence, earthquakes, floods, and effects of climate change
- Options to reduce the impacts of these factors
- Options to restore salmon and other fisheries that use the Delta estuary

The bill added section 139.2 of the Water Code: "The department shall evaluate the potential impacts on water supplies derived from the Delta based on 50-, 100-, and 200-year projections for the following possible impacts on the Delta of subsidence; earthquakes; floods; and changes in precipitation, temperature, and ocean levels; and a combination of these impacts"

DWR and DFG published their first evaluation report as required by AB 1200 in January 2008. The report, titled "Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento-San Joaquin Delta," was issued in 2008 and summarizes the potential risks to water supplies in the Sacramento-San Joaquin Delta attributable to future subsidence, earthquakes, floods, and climate change. The report identifies potential improvements to reduce these risks (DWR and DFG 2008). This report was based in part on the information provided as part of the Delta Risk Management Strategy investigations and analyses, also developed in 2008 and mandated by DWR.

6.2.2.7 Central Valley Flood Protection Board

The CVFPB, previously known as the Reclamation Board, was created in 1911. Its purpose was to help manage flood risks in the Central Valley on a systemwide basis through the development of a comprehensive flood-control plan for the Sacramento and San Joaquin rivers, and to act as the non-federal sponsor for federal flood-control projects in the Central Valley. The CVFPB has jurisdiction throughout the Sacramento and San Joaquin valleys, which is synonymous with the drainage basins of the Central Valley, and includes the Sacramento-San Joaquin Drainage District.

The CVFPB's mission is:

- To control flooding along the Sacramento and San Joaquin rivers and their tributaries in cooperation with the USACE.
- To cooperate with various agencies of the federal, State, and local governments in establishing, planning, constructing, operating, and maintaining flood control works.
- To maintain the integrity of the existing flood control system and designated floodways through its regulatory authority by issuing permits for encroachments.

The CVFPB is a major partner for federal flood control works in the Central Valley. The CVFPB shares costs with the federal government and the local districts and provides land easements and rights-of-way for federal projects. The CVFPB assumes responsibility for operation and maintenance only after a local maintenance agency has agreed to assume ultimate responsibility for the operation and maintenance. The CVFPB also approves or denies plans for reclamation, dredging, or improvements that alter any project levee. It has authority to approve or deny any land reclamation plan (related to public works) or flood protection that involves excavation near rivers and

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tributaries, and has legal responsibility for oversight of the entire Central Valley flood management system.

The CVFPB also adopts floodway boundaries and approves uses within those floodways. The purpose of the designated floodway program is to control encroachments and development within the floodways and to preserve floodways to protect lives and property. Various uses are permitted in the floodways, such as agriculture, canals, low dikes and berms, parks and parkways, golf courses, sand and gravel mining, structures that will not be used for human habitation, and other facilities and activities that will not be substantially damaged by the base flood event and will not cause adverse hydraulic impacts that will raise the water surface in the floodway. A permit from CVFPB is required for most activities other than normal agricultural practices within the boundaries of designated floodways. The only designated floodways in the Delta are along the Cosumnes and Mokelumne rivers up to their confluence with each other and the Stanislaus River up to its confluence with the San Joaquin River.

Title 23 of the California Code of Regulations and the Water Code provide guidance to DWR and CVFPB on how to enforce appropriate standards for flood control projects in the Central Valley. These codes provide DWR and CVFPB with the authority to enforce standards for the erection, maintenance, and operation of levees, channels, and other flood control works within their jurisdiction.

6.2.2.8 Delta Protection Act of 1992

The Delta Protection Act is described in Section 1.0, Water Resources Regulatory Framework. The Delta Protection Act of 1992 created the Delta Protection Commission and declared that a primary goal of the State for the Delta is, among other findings, to improve flood protection by structural and nonstructural means to ensure an increased level of public health and safety. Section 29704 of the Delta Protection Act focuses on the Delta levee system. The section recognizes that some of the Delta islands are flood prone, and that improvement and ongoing maintenance of the levee system is very important to protect farmlands, population centers, the State's water quality, and significant natural resource and habitat areas of the Delta. Section 29704 also notes that most of the existing levee systems are degraded and in need of restoration, improvement, and continuing management.

Other sections include goals pertaining to the quality of the Delta environment (agriculture, wildlife habitat, and recreational activities) and the balanced conservation and development of Delta land resources.

6.2.2.9 State Realty Disclosure Law

California law (Government Code [Government Code] section 8589.3) requires the seller (if acting without an agent) or the seller's agent to disclose to a prospective transferee of real property if the property is located within an SFHA (any type Zone "A" or "V") as designated by FEMA pursuant to 42 USC section 4001. Disclosure must be made if:

- A seller (if acting without an agent) or the seller's agent has "actual knowledge" (Public Resources Code section 2621.9(c)(1)) that the property is located within a SFHA, or
- The local jurisdiction has compiled a list of properties (identified by parcel) that are within an SFHA and a notice has been posted at the offices of the county recorder, county assessor, and county planning agency that identifies the location of the parcel list.

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I would say "down" to its confluence with the San Joaquin River rather than "up".

6.2.3 Regional and Local Plans, Policies, and Regulations

Local and regional flood management is provided through reclamation districts, individual cities and counties, and regional agencies composed of a combination of the former three, and created through a Joint Exercise of Powers Agreement.

The six counties that have lands within the Delta, as well as cities and special districts, are engaged in activities to reduce the risk of flooding. Activities may include construction, operation, and maintenance of structural features such as levees, and nonstructural activities. Nonstructural activities reduce property damage and loss of life and minimize economic impact in the event of a flood. These include floodplain zoning, enforcement of building restrictions in FEMA designated regulatory floodplains, flood warning and evacuation plans, and flood proofing and relocation assistance.

Several regional flood control agencies also address the Delta. The Sacramento Area Flood Control Agency is a regional agency charged with flood risk reduction to the City of Sacramento, other portions of Sacramento County, and portions of Sutter County. SAFCA's flood control system features include levees along the Sacramento River that protect Natomas and Sacramento, levees on the American River in Sacramento, and levees and floodwalls along the South Sacramento County Streams Group (SAFCA Website 2009).

The San Joaquin Area Flood Control Agency is responsible for flood protection for the City of Stockton and San Joaquin County. In 1998, it completed the Flood Protection Restoration Project, which consisted of improvements to levees, floodwalls, and channels that removed most of the City of Stockton from the FEMA 100 year flood zone (USACE 2008b).

The West Sacramento Flood Control Agency provides flood protection improvements to lower the flood risk to the City of West Sacramento.

[Note to Lead Agencies: this section is in preparation, and will include information related to DWR agreements with North Delta Water Agency, City of Antioch, CCWD, Solano County Water Agency, and Yolo County Flood Control and Water Conservation Districts.]

This section describes the potential effects of the action alternatives on surface water resources within the Delta, areas upstream of the Delta, and portions of the SWP and CVP Export Service Areas that could be directly affected by implementation of the alternatives. As previously described in this chapter, some of the SWP and CVP water supplies are conveyed in rivers and streams within Sacramento River and San Joaquin River basins, and thereby, affect surface water flows in these basins. In San Francisco Bay, Central Coast, South Coast, Tulare Lake, South Lahontan, and Colorado River hydrologic basins, SWP and CVP water supplies are conveyed in pipelines and canals and do not directly affect surface waters. Construction of facilities under the alternatives all would occur in the Delta of the Sacramento River and San Joaquin River basins. Therefore, the environmental consequences are focused on changes in surface water resources in the Sacramento River and San Joaquin River basins. Chapter 8, Water Quality, describes potential effects to surface water quality in the Sacramento and San Joaquin River basins and the Delta.

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Is it Colorado River or Colorado Desert?

6.3 Environmental Consequences

[*Note to Lead Agencies: figures for this chapter and Appendix 4A are in preparation.*]

6.3.1 Methods for Analysis

The surface water analysis addresses changes to surface waters affected by changes in SWP and CVP operations in the Delta Region, Upstream of the Delta Region, and Export Service Areas due to implementation of BDCP conveyance facilities (CM1) and other conservation measures, especially tidal marsh habitat restoration. The alternatives would modify the operations of the SWP and CVP facilities but would not modify the operations of water resources facilities owned and/or operated by other water rights holders. Therefore, surface water resources on many of the tributaries of the Sacramento River and San Joaquin River would not be affected. The surface waters analyzed in this chapter include Sacramento River upstream of the Delta and downstream of Keswick Dam, Trinity River downstream of Lewiston Reservoir, Feather River downstream of Thermalito Dam, American River downstream of Nimbus Dam, surface water diversions into Yolo Bypass, representative Delta channels, and San Joaquin River upstream of the Delta.

6.3.1.1 Quantitative Analysis of Surface Water Resources

The quantitative surface water analysis was conducted using the CALSIM II model. A brief overview of the modeling tools and outputs is provided in Chapter 4, Approach to Environmental Analysis, and a full description of the tools is included in Appendix 4A.

The results of the model alternative simulations are compared to CEQA existing conditions base line and to the NEPA No Action Alternative baseline to assess potential effects of changes in SWP and CVP operations to surface water resources. SWP and CVP water supply operations are managed to meet instream flow requirements, water rights agreements, and refuge water supply agreements in the Sacramento and San Joaquin valleys. Water supplies are provided in a consistent manner in the existing conditions, No Action Alternative, and alternatives for water rights holders (including Delta water rights holders), and refuge water supply agreements. Water quality changes in the surface water resources are described in Chapter 8, Water Quality.

SWP and CVP operations are determined in accordance with federal and state regulations and assumptions for each alternative, as described in Appendix 4A. Factors that effect surface water resources include operational requirements related to water supplies provided by SWP and CVP facilities (including water supplies to downstream water rights holders), SWP and CVP reservoir storage, and Delta outflow. As described in Chapter 5, Water Supply, the ability to release water from storage to SWP and CVP water users is dependent upon the capability of the reservoir to store adequate water to meet: 1) instream releases, especially with cold water to protect aquatic resources, and 2) Delta outflow requirements identified as "X2" to maintain freshwater conditions in the western Delta (as described in Chapter 8, Water Quality). Delta outflow is also considered in the determination of the ability to divert water at the SWP and CVP south Delta intakes to minimize "reverse flow" conditions in which water from the western Delta is conveyed upstream towards the intakes when Delta outflow is relatively low, as described in Appendix 4A.

The discussion in this chapter related to changes in surface water resources as related to changes in SWP and CVP water supply availability in the No Action Alternative and other alternatives is represented by descriptions of the following factors.

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- SWP and CVP reservoir storage as it relates to flood management operations.
  - Shasta Lake
  - Trinity Lake
  - Lake Oroville
  - Folsom Lake
- Instream flows.
  - Sacramento River at Freeport (downstream of the confluence with American River and diversions into Yolo Bypass and Sacramento Bypass)
  - San Joaquin River at Vernalis (near where the river enters the Delta)
  - Sacramento River downstream of potential north Delta intakes (and upstream of Delta Cross Channel gates)
  - Trinity River downstream of Lewiston Reservoir
  - American River downstream of Nimbus Dam
  - Feather River downstream of Thermalito Dam
  - Spills into the Yolo Bypass at Fremont Weir
- Combined flows for Old and Middle Rivers as an indication of reverse flow conditions in the south Delta.

Methods to Analyze Changes due to Implementation of Alternatives versus Changes due to Sea Level Rise and Climate Change

The analysis presented in this chapter compares simulated surface water conditions in the following manner:

- Existing conditions (without sea level rise or climate change) and No Action Alternative (without sea level rise or climate change)
- Existing conditions (without sea level rise or climate change) and alternatives (with sea level rise and climate change that would occur at Late Long Term around Year 2060)
- No Action Alternative (without sea level rise or climate change) and alternatives (with sea level rise and climate change that would occur at Late Long Term around Year 2060)

The results of the comparison of existing conditions and No Action Alternative to the alternatives reflect differences in water supply conditions due to the following two changes:

- Changes in surface water conditions due to operations of new facilities constructed under the alternative and related changes in SWP/CVP operations, and
- Changes in surface water conditions due to sea level rise and climate change.

Changes Due to Sea Level Rise

As sea level rise occurs, salinity would increase in the western and central Delta. The No Action Alternative and all of the alternatives include criteria to maintain freshwater in the western Delta in the spring (Spring X2), and the No Action Alternative and some of the alternatives include criteria to

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maintain Fall X2. There were no changes in the location of X2 (and the related extent of freshwater in the western Delta) in the No Action Alternative or alternatives when sea level rise occurred. As sea level rise occurs, more water would need to be released from the SWP and CVP reservoirs to maintain X2 criteria, therefore, less water would remain in storage at the end of September and less water would be available for SWP and CVP water supplies both upstream and downstream of the Delta.

Increased salinity in the west Delta near Rock Slough with sea level rise also would change the ability to divert water from the south Delta intakes sometimes in the fall months. If the salinity is greater than the allowed criteria, as described in Chapter 8, Water Quality, operations of south Delta intakes would be limited and water is released from the SWP and CVP reservoirs to maintain fresh water conditions at Rock Slough. Therefore, less water would be available for SWP and CVP water supplies downstream of the Delta.

The effects do not occur in the No Action Alternative which assumes the same sea level as in existing conditions.

Changes Due to Climate Change

In the future, changes in climate change are assumed to increase the amount of rainfall and decrease the amount of snow that would occur in the Sacramento and San Joaquin rivers watersheds. Therefore, peak runoff would be more likely in the late winter and early spring and runoff during the late spring and summer would be reduced as compared to existing conditions and No Action Alternative. These conditions could result in higher flood potential in the winter and early spring months.

Reduction in runoff from snowmelt in the summer months would reduce the ability of the SWP and CVP reservoirs to refill as water is released for downstream water supplies, instream flows, and Delta outflow. The reduction in reservoir storage would reduce water supply availability for SWP and CVP water users both upstream and downstream of the Delta.

Reduction in runoff in the summer months also would reduce instream flows in the Sacramento and San Joaquin River. Operations of the south Delta intakes under the No Action Alternative and alternatives would be dependent upon inflow/export and export/inflow ratios. If there is less inflow into the Delta, less water can likely be exported by the SWP and CVP.

The ability to operate the south Delta intakes also would be limited with less inflow from the San Joaquin River. The San Joaquin River inflows provide positive Old and Middle River outflows, and operations of the south Delta intakes lead to negative Old and Middle River outflows. The No Action Alternative and the alternatives that rely upon south Delta intakes operate with criteria to minimize reverse flows. If those criteria cannot be achieved, operations of the south Delta intakes could be limited and less water would be available for export

Describing Changes Due to Sea Level Rise and Climate Change as Compared to Changes Due to New Facilities and Operations

The differences in water stored in the SWP/CVP reservoirs upstream of the Delta, instream flows in rivers upstream of the Delta, and Old and Middle River reverse flow conditions due to sea level rise and climate change are shown through a comparison of No Action Alternative and No Action Alternative Late Long Term, as presented in Section 6.4, Cumulative Analysis, and described for each alternative in this section too. In general, the incremental differences in surface water

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conditions under No Action Alternative due to sea level rise and climate change are similar or greater than the differences in surface water conditions under the alternatives as compared to surface water conditions under the alternatives.

For each alternative, the following impact assessment comparisons are presented for the quantitative analyses of reservoir storage, instream flows, and Old and Middle River reverse flow conditions.

- Comparison of each alternative (at Late Long Term) to existing conditions. which will result in changes in surface water conditions that caused by sea level rise, climate change, and implementation of the alternative. It is not possible to specifically define the exact extent of the changes due to implementation of the alternative using the model simulation results presented in this chapter.
- Comparison of each alternative (at Late Long Term) to No Action Alternative which will result in changes in surface water conditions that caused by sea level rise, climate change, and implementation of the alternative. It is not possible to specifically define the exact extent of the changes due to implementation of the alternative using the model simulation results presented in this chapter.
- Comparison of No Action Alternative Late Long Term to No Action Alternative to indicate the general extent of changes in surface water conditions due to sea level rise and climate change.
- Comparison of each alternative (at Late Long Term) to No Action Alternative Late Long Term (which is included in Section 6.4, Cumulative Analysis) to indicate the general extent of changes in surface water conditions due to implementation of the alternative.

Mitigation measures are related to the changes due to implementation of the alternative and not changes due to sea level rise and climate change. Therefore, mitigation measures are related to the comparison of each alternative to No Action Alternative Late Long Term.

If sea level rise and climate change do not occur or occur differently than modeled for these analyses, surface water conditions under the alternatives will be different than the results of the model presented in this section.

6.3.1.2 Qualitative Analysis of Flood Management

Changes in flood potential could occur in several ways. First, changes in SWP and CVP operations could change available reservoir storage volumes that would be used to store runoff from snowmelt and rainstorm in the upper watersheds. Second, instream flow releases during spring months could change instream flows.

Quantitative analysis of flood potential due to changes in SWP and CVP operations would require calculation and evaluation of peak hourly flows in the main river, such as the Sacramento River, and the hourly addition of peak hourly flows from tributaries, such as Morrison Creek. The quantitative surface water analysis was conducted using CALSIM II, a monthly time step model. The model cannot accurately simulate peak hourly flow conditions for both the Sacramento River and the tributaries. Without the capability of simulating peak hourly flows, it is not possible to quantitatively analyze potential flood flows. Therefore, to analyze changes in flood potential related to reservoir storage, a qualitative evaluation will be conducted by comparing changes in reservoir storage at the end of May. If the reservoir storage has increased by the end of May, this could be an indication that there could be less opportunity to capture runoff from the upper watershed during the spring

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The USACE would still control the space behind these reservoirs reserved for flood reduction and the operation of that space.

months. The analysis evaluates changes in storage for Shasta Lake, Oroville Reservoir, and Folsom Lake. The analysis does not evaluate changes in storage for reservoirs on the San Joaquin River because the operations of Millerton Lake were not changed in the alternatives.

To qualitatively evaluate changes in flood potential within the Sacramento River and San Joaquin River, predicted peak monthly flows during wet years were compared to flood warning levels in the Sacramento River at Freeport (80,000 cfs) and San Joaquin River at Vernalis (32,500 cfs).

Assumptions for snowfall and rainfall patterns under Existing Conditions and No Action Alternative are not the same as snowfall and rainfall patterns under the alternatives. Existing Conditions and No Action Alternative precipitation assumptions are consistent with historical patterns. These historical patterns have been used by USACE and DWR to develop reservoir storage criteria to reduce flood potential in the watersheds, especially related to snowmelt in the spring months. The assumptions for snowfall and rainfall patterns for the alternatives have been modified to reflect climate change that is anticipated to increase surface water runoff from rainfall in the winter and early spring and decrease runoff from snowmelt in the late spring and early summer, as described in Chapter 5, Water Supply. However, the flood management criteria for maintaining adequate flood storage space in the reservoirs were not modified to accommodate climate change.

6.3.1.3 Analysis of Surface Water Conditions due to Construction and Operation of Conveyance Facilities in the Delta

Construction of facilities within or adjacent to waterways could change surface water elevations or runoff characteristics. The analysis describes the potential for temporary construction and long-term operations activities of the conveyance and the ecosystem restoration facilities to directly or indirectly affect local surface water resources related to the following.

- Substantial alterations of existing drainage patterns or streams, or increased rate or amount of runoff that would result in flooding.
- Increased runoff which would exceed the capacity of existing or planned stormwater systems.
- Construction of housing within a 100-year flood hazard area.
- Exposure of people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam.
- Construction of structures within a 100-year flood hazard area which would impede or redirect flood flows, or be subject to inundation by seiche, tsunami, or mudflow.

6.3.1.4 Project- and Program-Level Components

For this analysis changes in SWP and CVP surface water resources are evaluated at a project level if sufficient detail is available. It should be noted that SWP/CVP water supply operations are affected both by specific operations criteria identified for each alternative at a project level basis and by assumptions for the location and extent of tidal marsh restoration for each alternative that is identified only at a programmatic level.

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6.3.2 Determination of Adverse Effects

Effects on surface water conditions were considered adverse if implementation of an alternative would result in one of the following conditions.

- An increase of more than 1% in SWP or CVP reservoir storage in reservoirs located upstream of the Delta in May that could indicate a reduced ability to store flood waters in the winter and spring under the alternatives as compared to reservoir storage under the No Action Alternative Late Long Term (which is used to avoid consideration of changes in reservoir storage caused by sea level rise and climate change). The value of 1% is used to avoid consideration of minor fluctuations in model output due to simulation techniques and assumptions.
- High monthly flows in wet years when flood potential is high in the Sacramento River at Freeport, San Joaquin River at Vernalis, Feather River at Thermalito Dam, or Yolo Bypass at Fremont Weir that exceeded flood capacity at these locations s under the alternatives as compared to river flows under the No Action Alternative Late Long Term (which is used to avoid consideration of changes in river flows caused by sea level rise and climate change).
- An increase or more than 1% in flows in the Sacramento River downstream of the proposed locations of north Delta intakes, Trinity River at Lewiston Dam, and American River at Nimbus Dam under the alternatives as compared to high monthly flows in wet years under the No Action Alternative Late Long Term (which is used to avoid consideration of changes in reservoir storage caused by sea level rise and climate change). The value of 1% is used to avoid consideration of minor fluctuations in model output due to simulation techniques and assumptions.
- An increase of more than 1% in reverse flow conditions in Old and Middle River under the alternatives as compared to reverse flows under the No Action Alternative Late Long Term (which is used to avoid consideration of changes in reverse flows caused by sea level rise and climate change). The value of 1% is used to avoid consideration of minor fluctuations in model output due to simulation techniques and assumptions.
- Any alteration of the existing drainage pattern of the site or area of a constructed facility, including through the alteration of the course of a stream or river; or substantial increase in the rate or amount of surface runoff in a manner which would result in flooding on or offsite.
- Creation or contribution of runoff water from a constructed facility which would exceed the capacity of existing or planned stormwater drainage systems.
- Any change that would increase exposure of people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of constructed facility.
- Any construction of a facility within a 100 year flood hazard area that would impede or redirect flood flows, or be subject inundation by mudflow.

The alternatives would not include construction of housing, therefore, this analysis does not include an evaluation of potential flood hazards due to construction of housing within a 100 year flood hazard area as mapped on a federal Flood Hazard Boundary or FIRM or other flood hazard delineation map.

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The facilities under existing conditions, No Action Alternative, and alternatives would not be located in areas that would be subject to tsunamis or seiches, therefore, this analysis does not evaluate the potential for inundation by these phenomena.

6.3.3 Effects and Mitigation Approaches

6.3.3.1 No Action Alternative

The No Action Alternative would include continued implementation of existing maintenance, enforcement, and protection programs by federal, state, and local agencies, as well as projects that are permitted or under construction. Operations of the SWP and CVP facilities would change under the No Action Alternative due to increased water rights demands and implementation of a provision in U.S. Fish and Wildlife Service 2008 Biological Opinion (USFWS 2009), as described below.

- Increased water rights demands of 482 TAF would occur by 2025. This is primarily an increase in water rights demands for urban municipal and industrial use north of the Delta, especially in the communities in El Dorado, Placer, and Sacramento counties. The increased water rights demand would reduce water supply availability to SWP and CVP water contractors located upstream and downstream of the Delta and related instream flows that occur during conveyance of the reduced water supplies.
- Operations of the SWP and CVP under the No Action Alternative would include operations to meet Fall X2 criteria (see Appendix 4A). These criteria would require release of water from the SWP and CVP reservoirs in the fall and reduce water supply availability for , and therefore, reduce SWP and CVP water contractors located upstream and downstream of the Delta and related instream flows that occur during conveyance of the reduced water supplies.

A detailed description of the modeling assumptions associated with the No Action alternative is included in Appendix 4A.

SWP and CVP Reservoir Storage in May and Related Changes to Flood Potential

Reservoir storage in May under long term average conditions for No Action Alternative in Shasta Lake and Trinity Lake would be reduced by less than 1%; storage in Oroville Reservoir, and Folsom Lake is reduced by less than 2% as compared to existing conditions, as summarized in Figures 6 10 through 6–13. The changes primarily would be related to increased water rights demands in the Sacramento River watershed. The changes in reservoir storage would be beneficial related to potential flood management.

Spring Monthly Flows during Wet Years in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

As described above, analysis of monthly flows in the spring months during wet years could be indicative of the potential for changes in flood management in the Sacramento River at Freeport, San Joaquin River at Vernalis, Sacramento River upstream of Walnut Grove which would be downstream of proposed locations of north Delta intakes in the alternatives, Trinity River downstream of Lewiston Dam, American River downstream of Nimbus Dam, Feather River downstream of Thermalito Dam, and Yolo Bypass at Fremont Weir.

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Sacramento River at Freeport

Peak monthly flows occur in the Sacramento River at Freeport in February over the long term average and during wet years, as shown in Figures 6 14 and 6 15. There would be no changes in the high monthly flows at these locations in the No Action Alternative as compared to existing conditions, and the flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport.

San Joaquin River at Vernalis

Peak monthly flows occur in the San Joaquin River at Vernalis in March over the long term average and during wet years, as shown in Figures 6 16 and 6 17. There would be no changes in the high monthly flows at these locations in the No Action Alternative as compared to existing conditions, and the flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

Sacramento River at Locations Upstream of Walnut Grove

Peak monthly flows occur in the Sacramento River upstream of Walnut Grove in February over the long term average and during wet years, as shown in Figures 6 18 and 6 19. There would be no changes in the high monthly flows at these locations in the No Action Alternative as compared to existing conditions.

Trinity River Downstream of Lewiston Dam

Peak monthly flows occur in the Trinity River downstream of Lewiston Dam in May over the long term average and during wet years, as shown in Figures 6 20 and 6 21. There would be no changes in the high monthly flows at these locations in the No Action Alternative as compared to existing conditions.

American River Downstream of Nimbus Dam

Peak monthly flows occur in the American River downstream of Nimbus Dam in January and February over the long term average and during wet years, as shown in Figures 6 22 and 6 23. There would be no changes in the high monthly flows at these locations in the No Action Alternative as compared to existing conditions.

Feather River Downstream of Thermalito Dam

Peak monthly flows occur in the Feather River downstream of Thermalito Dam in January through March over the long term average and during wet years, as shown in Figures 6 24 and 6 25. Flood releases from Lake Oroville to the lower Feather River are generally less than 150,000 cfs when storage is within the upper flood control space of Lake Oroville. Under No Action Alternative, peak monthly flows and long term average flows would decrease in the Feather River as compared to flows under existing conditions. The potential for increase flood risk based upon analysis of monthly flows would not be an adverse impact.

Yolo Bypass at Fremont Weir

Water generally spills into Yolo Bypass at Fremont Weir when the combined flows in the Sacramento River and Feather River upstream of Fremont Weir and flows from Sutter Bypass exceed 56,000 cfs. The Yolo Bypass floodplain capacity can accommodate a flow at Fremont Weir up

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to 343,000 cfs. Under No Action Alternative, peak flows into the Yolo Bypass at Fremont Weir would be less than under existing conditions and less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir, as shown in Figure 6 26. Therefore, the potential for increase flood risk based upon analysis of monthly flows would be beneficial.

Reverse Flows in Old and Middle River

Reverse flow conditions for Old and Middle River flows on a long term average basis is similar under the No Action Alternative as compared to existing conditions except in September through November. During those months, flows in Old and Middle River would be more positive towards the Delta due to operations to comply with Fall X2 which reduces operations of the SWP/CVP south Delta intakes during those months, as shown in Figure 6 27.

Ongoing Plans, Policies, and Programs

The programs, plans, and projects included under the No Action Alternative are summarized in Chapter 3, Description of Alternatives. Most of the projects would not affect surface water resources under No Action Alternative as compared to existing conditions. The projects that could affect SWP/CVP water supply availability are summarized in Table 6 2, along with their anticipated effects to water supply.

Table 6 2. Effects on Surface Water Resources from the Plans, Policies, and Programs for the No Action Alternative

Agency	Program/Project	Status	Description of Program/Project	Effects to Water Supply
Contra Costa Water District, Bureau of Reclamation, and California Department of Water Resources	Middle River Intake and Pump Station (previously known as the Alternative Intake Pump Station)	Project completed and was formally dedicated July 20, 2010	This project includes a potable water intake and pump station to improve drinking water quality for Contra Costa Water District customers.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (CCWD 2006).
California Department of Water Resources	Federal Energy Regulatory Commission (FERC) License Renewal for Oroville Project	Draft Water Quality Certification issued December 6, 2010 and comments on Draft received December 10, 2010	The renewed federal license will allow the Oroville Facilities to continue providing hydroelectric power and regulatory compliance with water supply and flood control.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (DWR 2008c).
Freeport Regional Water Authority and Bureau of Reclamation	Freeport Regional Water Project	Project was completed late 2010.	Project includes an intake/pumping plant near Freeport on the Sacramento River and a conveyance structure to transport water through Sacramento County to the Folsom South Canal.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (FRWA 2003).

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Agency	Program/Project	Status	Description of Program/Project	Effects to Water Supply
California Department of Water Resources and Solano County Water Agency	North Bay Aqueduct Alternative Intake Project	Study is ongoing.	This project will construct an alternative intake on the Sacramento River and a new segment of pipeline to connect it to the North Bay Aqueduct system.	No adverse effects on surface water supplies are anticipated because the total diversions would be similar as the diversions allowed under the existing conditions.
City of Stockton	Delta Water Supply Project	Expected completion in 2012.	This project consists of a new intake structure and pumping station adjacent to the San Joaquin River; a water treatment plant along Lower Sacramento Road; and water pipelines along Eight Mile, Davis, and Lower Sacramento Roads.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (Stockton 2005).
Tehama Colusa Canal Authority and Bureau of Reclamation	Red Bluff Diversion Dam Fish Passage Project	Expected completion in 2012.	Proposed improvements include modifications made to upstream and downstream anadromous fish passage and water delivery to agricultural lands within CVP.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (Reclamation 2002).
Bureau of Reclamation, California Department of Fish and Game, and Natomas Central Mutual Water Company	American Basin Fish Screen and Habitat Improvement Project	Expected completion in 2012.	This three phase project includes consolidation of diversion facilities; removal of decommissioned facilities; aquatic and riparian habitat restoration; and installing fish screens in the Sacramento River. Total project footprint encompasses about 124 acres east of the Yolo Bypass.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (Reclamation 2008).
Bureau of Reclamation	Delta Mendota Canal/California Aqueduct Intertie	Expected completion in 2012.	The purpose of the intertie is to better coordinate water delivery operations between the California Aqueduct (state) and the Delta Mendota Canal (federal) and to provide better pumping capacity for the Jones Pumping Plant. New project facilities include a pipeline and pumping plant.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (Reclamation 2009).

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Agency	Program/Project	Status	Description of Program/Project	Effects to Water Supply
Zone 7 Water Agency and California Department of Water Resources	South Bay Aqueduct Improvement and Enlargement Project	Expected completion in 2012.	The project includes construction of a new reservoir and pipelines and canals to increase the capacity of the South Bay Aqueduct.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (DWR 2004).

CEQA Conclusion: Surface water resources under No Action Alternative would be similar to conditions under existing conditions. There would be less reverse flows in Old and Middle Rivers under No Action Alternative as compared to existing conditions due to operations of the SWP and CVP to comply with Fall X2 criteria. In total, the ongoing programs and plans under the No Action Alternative would not result in adverse effects on surface water resources based upon information presented in related environmental documentation.

6.3.3.2 Alternative 1A—Dual Conveyance with Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario A)

Alternative 1A would result in temporary effects on lands and communities associated with construction of five intakes and intake pumping plants, and other associated facilities; two forebays; conveyance pipelines; and tunnels. Nearby areas would be altered as work or staging areas, concrete batch plants, fuel stations, or be used for spoils disposal areas. Sites used temporarily for borrow and then for spoils would also be anticipated to have a temporary effect on lands and communities. Transmission lines, access roads, and other incidental facilities would also be needed for operation of the project and construction of these structures would have temporary effects on lands and communities.

Changes in SWP/CVP operations under Alternative 1A would result in changes to surface water conditions. For example, most of the diversions at the north Delta intakes would occur in winter and spring, and most of the diversions at the south Delta intakes would occur in the summer under Alternative 1A. Alternative 1A does not include inflow/export ratio criteria for the San Joaquin River that limits use of the south Delta intakes under existing conditions and No Action Alternative.

Alternative 1A also would include installation of operable gates at Fremont Weir to increase the frequency and duration of inundation of Yolo Bypass and modification of islands and channels in the Delta and Suisun Marsh to establish tidal marsh, channel margin, and riparian corridor habitat as compared to existing conditions and No Action Alternative.

Alternative 1A would not include operations to comply with Fall X2 criteria. The Fall X2 criteria, as included in No Action Alternative, increases releases from SWP/CVP reservoirs upstream of the Delta to increase Delta outflow in September through November when the previous years were above normal and wet water years. In October, Delta outflows under Alternative 1A, would increase to reduce salinity in the west Delta and comply with water quality criteria at Rock Slough, as under existing conditions and No Action Alternative.

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Impact SW-1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Under Alternative 1A, reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6-10 through 6-13. However, these differences represent changes under Alternative 1A and changes due to sea level rise and climate change.

Changes due to sea level rise and climate change are indicated through the comparison of or reservoir storage under No Action Alternative Late Long-Term as compared to reservoir storage under No Action Alternative. Reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6-10 through 6-13, due to sea level rise and climate change.

As described in Section 6.4, Cumulative Analysis, and shown in Figures 6-10 through 6-13, reservoir storages in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake at the end of May under Alternative 1A would be equal to or less than reservoir storage under No Action Late Long-Term. The reduced storage volumes would allow for storage of additional runoff that could reduce the potential for flooding downstream of the reservoirs. The effect would be beneficial related to flood management.

CEQA Conclusion: Alternative 1A would increase the ability to store runoff in the spring in the upper Sacramento River watershed, and therefore, could reduce the potential for flooding downstream of the reservoirs. Therefore, Alternative 1A would result in a less than significant impact on flood management.

Impact SW-2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Sacramento River at Freeport

Under Alternative 1A, high monthly flows in the Sacramento River at Freeport in February under would be about 3% higher than flows under existing conditions and about 4% higher than flows under No Action Alternative, as shown in Figure 6-14. However, these differences represent changes under Alternative 1A and changes due to sea level rise and climate change.

High monthly flows in wet years in the Sacramento River at Freeport in February under No Action Alternative Late Long-Term would be about 5% higher than under No Action Alternative, as shown in Figure 6-14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport.

High monthly flows in wet years in the Sacramento River at Freeport in February under Alternative 1A would be lower than under No Action Alternative Late Long-Term, as shown in Figure 6-14. On a monthly basis, flood potential at these locations would not change under Alternative 1A as compared to No Action Alternative Late Long-Term. Therefore, Alternative 1A would result in a beneficial impact on flood management.

San Joaquin River at Vernalis

Under Alternative 1A, high monthly flows in the San Joaquin River at Vernalis in March in wet years would be about 5% higher than flows under existing conditions and about 6% higher under No

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Action Alternative, as shown in Figure 6 16. These differences represent changes under Alternative 1A and changes due to sea level rise and climate change.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under No Action Alternative Late Long Term would be about 6% higher than under No Action Alternative, as shown in Figure 6 14. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternative 1A would be equal to flows under No Action Alternative Late Long Term, as shown in Figure 6 14. On a monthly basis, flood potential at these locations would not change under Alternative 1A as compared to No Action Alternative Late Long Term. Therefore, Alternative 1A would result in no impact on flood management.

Sacramento River at Locations Upstream of Walnut Grove

Under Alternative 1A, high monthly flows in the Sacramento River downstream of the north Delta intakes in February would be less than under existing conditions and No Action Alternative, as shown in Figure 6 18. A portion of the reduction in flows would be due to climate change, especially in April through September when the flows under the No Action Alternative Late Long Term would be less than flows under No Action Alternative. However, flows downstream of the north Delta intakes would be reduced in all months on a long term average due to the operations of the north Delta intakes.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6 18.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternative 1A would be less than flows under No Action Alternative Late Long Term, as shown in Figure 6 18. On a monthly basis, flood potential at these locations would not change under Alternative 1A as compared to No Action Alternative Late Long Term. Therefore, Alternative 1A would result in a beneficial impact on flood management.

Trinity River Downstream of Lewiston Dam

Under Alternative 1A, high monthly flows in Trinity River downstream of Lewiston Lake in May in wet years would be similar to flows under existing conditions and No Action Alternative for, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under No Action Alternative Late Long Term would be similar to flows under No Action Alternative, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under Alternative 1A would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 20. On a monthly basis, flood potential at these locations would not change under Alternative 1A as compared to No Action Alternative Late Long Term. Therefore, Alternative 1A would result in no impact on flood management.

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American River Downstream of Nimbus Dam

Under Alternative 1A, high monthly flows in the American River at Nimbus Dam in January and February in wet years under Alternative 1A would be 20 to 30% higher than flows under existing conditions and No Action Alternative, as shown in Figure 6 22. These differences represent changes under Alternative 1A and changes due to sea level rise and climate change.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under No Action Alternative Late Long Term would be 20 to 30% higher than under No Action Alternative, as shown in Figure 6 22.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under Alternative 1A would be similar under No Action Alternative Late Long Term, as shown in Figure 6 22. On a monthly basis, flood potential at these locations would not change under Alternative 1A as compared to No Action Alternative Late Long Term. Therefore, Alternative 1A would result in no impact on flood management.

Feather River Downstream of Thermalito Dam

Under Alternative 1A, high monthly flows in wet years in the Feather River at Thermalito Dam in February would be 34% higher than flows under existing conditions and 44% higher than flows under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24. A portion of the changes would be related to climate change.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24 would not exceed channel capacity of 150,000 cfs in this location.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternative 1A would be 12% higher than under No Action Alternative Late Long Term because water is released from Lake Oroville for diversions at the north Delta intakes in the winter months, as described in Chapter 5, Water Supply. However, the average monthly flows in the high monthly flows would not exceed channel capacity of 150,000 cfs in this location. Therefore, Alternative 1A would not result in an adverse impact on flood management.

Yolo Bypass at Fremont Weir

Under Alternative 1A, peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years would be 37% higher than peak monthly spills under existing conditions and 40% higher than spills under No Action Alternative, as shown in Figure 6 26. A portion of the changes would be related to climate change.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 26.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternative 1A would be 9% higher than under No Action Alternative Late Long Term, as shown in Figure 6 26, because Alternative 1A operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass. as compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at

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General comment for all of these alternative analysis e.g. 37% higher peak monthly spills would appear to raise the water surface in the river resulting in greater risk to those people living behind the levees. The flow is less than the capacity of the Yolo Bypass, however, there is an increased risk to those people living behind the levee. The statement made in the first and second lines of page 6-53 is not correct. There is an adverse impact. This is typical for all of the alternatives that raise the water surface elevation.

Fremont Weir. Therefore, Alternative 1A would not result in an adverse impact on flood management.

Overall, Alternative 1A would not result in an increase in potential risk for flood management as compared to existing conditions and the No Action Alternative when the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 1A in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 1A would not result in adverse impacts on flood management.

***CEQA Conclusion*:** Alternative 1A would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 1A in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 1A would result in a less than significant impact on flood management. less than significant

Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be less likely under Alternative 1A on a long term average basis except in April and May as compared to reverse flows under existing conditions and No Action Alternative, as shown in Figure 6 27. Old and Middle River flows would be less positive in April and May under Alternative 1A as compared to flows under existing conditions and No Action Alternative because Alternative 1A does not include inflow/export ratio criteria for the San Joaquin River in those months. Therefore, Alternative 1A would result in beneficial impacts toward reductions in reverse flow conditions in Old and Middle Rivers in June through March and adverse impacts with increased reverse flow conditions in April and May.

Reverse flow conditions in Old and Middle Rivers would be affected by sea level rise and climate change. Under the No Action Alternative Late Long Term Reverse flow conditions for Old and Middle River flows would be less likely to occur on a long term average basis except in April and May as compared to reverse flows under No Action Alternative, as shown in Figure 6 27.

Reverse flow conditions under Alternative 1A would be less likely to occur on a long term average basis except in October and April as compared to No Action Alternative Late Long Term.

***CEQA Conclusion*:** Alternative 1A would provide benefits related to reducing reverse flows in Old and Middle Rivers in June through March and adverse impacts in increased reverse flow conditions in April and May as compared to existing conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Construction of the facilities under Alternative 1A would involve construction of intakes in the water and extensive facilities on the land, as well as construction of habitat restoration in the water.

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Construction of the earthen embankments, pumping plants, levees, canals, tunnel access shafts, forebays, and access roads included in Alternative 1A would require excavation, grading, or stockpiling at project facility sites or at temporary work sites. These activities would result in temporary and long term changes to drainage patterns, paths and facilities that would, in turn, cause changes in drainage flow rates, directions and velocities.

Site grading needed to construct any of the proposed facilities has the potential to block, reroute, or temporarily detain and impound surface water in existing drainages, which would result in increases and decreases in flow rates, velocities, and water surface elevations. Changes in drainage depths would vary depending on the specific conditions at each of the temporary work sites. As drainage paths would be blocked by construction activities, the temporary ponding of drainage water could occur and result in decreases in drainage flow rates downstream of the new facilities, increases in water surface elevations, and decreases in velocities upstream of the new facilities. Alternative 1A facilities could temporarily and directly affect existing water bodies and drainage facilities, including ditches, canals, pipelines, or pump stations.

These temporary changes in drainage would be minimized, and in some cases avoided, by construction of new or modified drainage facilities, as described in the Chapter 3, Description of Alternatives. Alternative 1A would include installation of temporary drainage bypass facilities, long term cross drainage, and replacement of existing drainage facilities that would be disrupted due to construction of new facilities. These facilities would be constructed prior to disconnecting or crossing existing drainage facilities. Locations of stockpiles and other temporary construction features would be selected to minimize flow impedance under flood flow conditions.

Paving, compaction of soil and other activities that would increase land imperviousness would result in decreases in precipitation infiltration into the soil, and thus increase drainage runoff flows into receiving drainages.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 3, Description of Alternatives, and Chapter 7, Groundwater), and discharged to local drainage channels or rivers. This would result in a localized increase in flows and water surface elevations in the receiving channels. Dewatering would be a continuous operation initiated one to four weeks prior to excavation and would continue after excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board.

Intakes constructed under Alternative 1Awould be on bank facilities that could encroach into the existing river cross section and would involve construction activities in the Sacramento River, at the northern end of the Delta. Construction of intakes would include the installation of cofferdams at each of the intake locations. The cofferdams would impede river flows, resulting in hydraulic impacts. Water surface elevations upstream of the cofferdams could increase under flood flow conditions by approximately 1/2 foot relative to existing conditions and No Action Alternative. Under existing regulations, the USACE, CVFPB, and DWR would require installation of setback levees or other measures to maintain existing flow capacity in the Sacramento River during construction and operations, which would prevent unacceptable increases in river water surface elevations under

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flood flow conditions, reverse flow areas, areas of high velocities that could result in scour, and reflection of flood waves towards other levees.

Sediment and debris would accumulate at the intake locations and periodic dredging would occur, as described in Chapter 3, Description of Alternatives.

Construction of project facilities could impact agricultural irrigation delivery and return flow canals, pumps and other drainage facilities in locations where such agricultural facilities would be crossed by intakes, pumping plants, forebays, pipelines, canals, and tunnel access shafts. Stockpiled excavated material from forebays and sediment basins could impact agricultural irrigation deliveries and return flows. Alternative 1A would include installation of temporary agricultural flow bypass facilities and provision of replacement drainage facilities to avoid interruptions in agricultural irrigation deliveries or return flows, as described in Chapter 3, Description of Alternatives. The temporary flow bypass facilities would be installed and connected before existing facilities would be disconnected or otherwise impacted. Replacement drainage facilities would be installed and connected before the end of construction of the proposed conveyance facilities.

Riparian habitat restoration is anticipated to occur primarily in association with the restoration of tidal marsh habitat, channel margin habitat, and inundated floodplains. The restored vegetation has the potential of increasing channel and/or floodplain roughness, which could result in increases in channel water surface elevations, including under flood flow conditions, and in decreased velocities. Modified channel geometries could increase or decrease channel velocities and/or channel water surface elevations, including under flood flow conditions. Under existing regulations, the USACE, CVFPB, and DWR would require the habitat restoration projects to be flood neutral. Measures to reduce flood potential could include channel dredging to increase channel capacities and decrease channel velocities and/or water surface elevations.

Expansion of seasonally inundated floodplain restoration areas generally would decrease flows in the existing channels under higher flow conditions, resulting in lower channel velocities and water surface elevations. Hydraulic roughness in the inundated floodplain areas could vary based on the land use that would be allowed there, whether riparian vegetation would be allowed to establish, farming would be continued, or residual crop biomass would be used to provide cover, hydrodynamic complexity, and organic carbon sources. However, because these inundated areas would provide new flow area relative to existing conditions and No Action Alternative, the overall hydraulic effect in the existing channels would be to lower channel velocities and water surface elevations under high flow conditions.

In total, Alternative 1A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 1A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

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Mitigation Measure SW‑4. Implement measures to reduce runoff and sedimentation

DWR will implement measures to reduce runoff in land‑side construction areas and sedimentation effects in water‑based construction sites. To reduce the potential for adverse impacts from large amounts of runoff from paved and impervious surfaces during construction or operations, DWR would design and implement on‑site drainage systems in areas where construction drainage is determined to be an issue. DWR would prepare drainage studies each construction location to assess the need for, and to finalize other drainage‑related design measures, such as a new on‑site drainage system or new cross drainage facilities. If necessary, onsite stormwater detention storage would be installed to minimize runoff during construction or operations.

To avoid changes in course of waterbodies, DWR would design measures to prevent accumulations in water‑bodies from substantially effecting river hydraulics. A detailed sediment transport study for all water‑based facilities would be conducted and a sediment management plan would be prepared and implemented during construction. The sediment management plan would include periodic and long‑term sediment removal actions.

Impact SW‑5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Construction of the facilities under Alternative 1A would contribute runoff from dewater facilities. As described under Impact SW‑4, paving, compaction of soil and other activities that would increase land imperviousness would result in decreases in precipitation infiltration into the soil, and could increase drainage runoff flows into receiving drainages.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 8, Water Quality), and discharged to local drainage channels or rivers. This would result in a localized increase in flows and water surface elevations in the receiving channels. Dewatering would be a continuous operation initiated one to four weeks prior to excavation and would continue after excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board, USACE, and CVFPB.

Alternative 1A actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 1A would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 1A actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 1A would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered

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significant. Mitigation Measure SW 4 would reduce this potential impact to a level of less than significant.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

Impact SW 6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

As described under Impact SW 4, facilities under Alternative 1A would be designed to avoid increased flood potential as compared to existing conditions or No Action Alternative in accordance with the requirements of the USACE, CVFPB, and DWR. As described under Impact SW 1, Alternative 1A would not increase flood potential on the Sacramento River, San Joaquin River, or Yolo Bypass.

Construction of intakes and stream crossing that would disturb existing levees would be required by USACE, CVFPB, and DWR to be designed in a manner that would not adversely effect existing flood protection. Facilities construction would include temporary cofferdams, stability analyses, monitoring and slope remediation, as described in Chapter 3, Description of Alternatives. For the slope stability impacts due to excavation of the existing levee for the Sacramento River intake structures, sheet pile wall installation would minimize the slope stability impacts during construction of the Sacramento River intakes. For the slope stability impacts due to excavation of the existing levee for the Byron Tract Forebay, tie back wall installation and dewatering to maintain slope stability and control seepage would minimize the slope stability impacts associated with construction of the forebay and approach canal embankments. For the slope stability impacts due to excavation adjacent to Clifton Court Forebay, providing for tunnel shaft support would minimize the slope stability impacts during excavation of the main tunnel shaft adjacent to the Clifton Court Forebay embankment. Dewatering inside the cofferdam or adjacent to the existing levees would remove waterside slope resistance and lead to slope instability. Slopes would be constructed in accordance with existing engineering standards, as described in Chapter 3, Description of Alternatives.

Some project facilities could require rerouting of access roads and waterways that could be used during times of evacuation or emergency response.

Construction of tidal marsh habitat, channel margin habitat, and inundated floodplains could increase flood potential due to impacts on adjacent levees. The newly flooded areas would have larger wind fetch lengths compared to the existing fetch lengths of the adjacent leveed channels. An increase in fetch length would result in increases in wave height and velocities that reach the existing levees along adjacent islands and floodplains. These potential increases in wave action could also reach the land side of the remaining existing levees around the restoration area. In accordance with existing requirements of the USACE, CVFPB, and DWR, Alternative 1A would be designed to avoid increased flood potential as compared to existing conditions or No Action Alternative.

Alternative 1A would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water

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areas of habitat restoration could cause potential damage to adjacent levees. This impact could become more substantial with sea level rise and climate change.

CEQA Conclusion: Alternative 1A would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a level of less than significant.

Mitigation Measure SW-6. Implement measures to address potential wind fetch issues

Wind fetch studies should be completed prior to construction of habitat restoration areas with increased open water in the Delta to determine levee protection methods for adjacent and nearby levees.

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject to inundation by mudflow

As described under Impact SW-4, facilities under Alternative 1A would include structures within the 100-year flood hazard area, but would not result in impeded or redirected flood flows or conditions that could lead to mudflows because the structures would be required to meet the criteria of the USACE, CVFPB, and DWR. As described under Impact SW-4, Alternative 1A also would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 1A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 1A would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4.

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6.3.3.3 Alternative 1B—Dual Conveyance with East Canal and Intakes 1–5 (15,000 cfs; Operational Scenario A)

Alternative 1B would result in temporary effects on land and communities in the study area associated with construction of five intakes and intake pumping plants, one forebay, pipelines, canals, tunnels, siphons, and an intermediate pumping plant; alter nearby areas for retrieval of borrowed soils and spoils and tunnel muck disposal; and require development of transmission lines, access roads, and other incidental structures. This alternative would differ from Alternative 1A primarily in that it would use a series of canals generally along the east section of the Delta to convey water from north to south, rather than long segments of deep tunnel through the central part of the Delta.

Operations of the facilities and implementation of the conservation measures would be identical to actions described under Alternative 1A.

Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Effects on SWP and CVP reservoir storage under Alternative 1B would be identical to those described for Impact SW 1 under Alternative 1A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on SWP and CVP reservoir storage under Alternative 1B would be identical to those described under Alternative 1A because the operations of the facilities would be identical. Therefore, Alternative 1A would result in a less than significant impact on flood management.

Impact SW 2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Effects on surface water flows under Alternative 1B would be identical to those described for Impact SW 2 under Alternative 1A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on surface water flows under Alternative 1B would be identical to those described under Alternative 1A because the operations of the facilities would be identical. Therefore, Alternative 1B would result in less than significant river flow impacts on flood management.

Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Effects on Old and Middle River flows under Alternative 1B would be identical to those described for Impact SW 3 under Alternative 1A because the operations of the facilities would be identical.

CEQA Conclusion: Alternative 1B would provide benefits related to reducing reverse flows in Old and Middle Rivers in June through March and adverse impacts in increased reverse flow conditions in April and May as compared to existing conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

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Impact SW-4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Effects on alteration of existing drainage patterns under Alternative 1B would be similar to those described for Impact SW-4 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects on drainage patterns would be the same. Due to the construction of canals under Alternative 1B as compared to tunnels, the potential for interruption of existing drainage facilities would be higher. However, the same types of activities related to installation of temporary and permanent drainage facilities and restoration of disturbed drainage facilities would occur under Alternative 1B as under Alternative 1A, as described in the Chapter 3, Description of Alternatives.

In total, Alternative 1B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 1B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects on surface waters due to runoff under Alternative 1B would be similar to those described for Impact SW-5 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects on surface waters would be the same. Due to the construction of canals under Alternative 1B as compared to tunnels, groundwater dewatering would over a larger area and the amount of dewatering would be increased because canals would require more dewatering activities than tunneling operations that can occur in high groundwater conditions. However, the same types of activities related to installation of temporary and permanent drainage facilities would occur under Alternative 1B as under Alternative 1A, as described in the Chapter 3, Description of Alternatives.

Alternative 1B actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 1B would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

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CEQA Conclusion: Alternative 1B actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 1B would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations. and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facilities.

Increased exposure of people or structures to flood risks under Alternative 1B would be similar to those described for Impact SW-6 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects related to flood potential would be the same and the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 1B would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW-6 in the discussion of Impact SW-6 under Alternative 1A.

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject to inundation by mudflow

Effects on flood potential would be similar under Alternative 1B to those described for Impact SW-7 under Alternative 1A because facilities would be designed to avoid increased flood potential as compared to existing conditions or No Action Alternative in accordance with the requirements of the USACE, CVFPB, and DWR. As described under Impact SW-4, Alternative 1B would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 1B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment

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accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 1B would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4.

6.3.3.4 Alternative 1C—Dual Conveyance with West Canal and Intakes W1–W5 (15,000 cfs; Operational Scenario A)

Alternative 1C would result in effects on lands and communities in the study area associated with construction of five intakes and intake pumping plants, one forebay, conveyance pipelines, canals, a tunnel, culvert siphons, and an intermediate pumping plant. Nearby areas would be altered for the deposition of spoils. Transmission lines, access roads, and other incidental facilities would also be needed for operation of the project and construction of these structures would have effects on lands and communities.

Operations of the facilities and implementation of the conservation measures would be identical to actions described under Alternative 1A.

Impact SW-1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Effects on SWP and CVP reservoir storage under Alternative 1C would be identical to those described for Impact SW-1 under Alternative 1A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on SWP and CVP reservoir storage under Alternative 1C would be identical to those described under Alternative 1A because the operations of the facilities would be identical. Therefore, Alternative 1C would result in a less than significant impact on flood management.

Impact SW-2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Effects on surface water flows under Alternative 1C would be identical to those described for Impact SW-2 under Alternative 1A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on surface water flows under Alternative 1B would be identical to those described under Alternative 1A because the operations of the facilities would be identical. Therefore, Alternative 1B would result in less than significant river flow impacts on flood management.

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Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Effects on Old and Middle River flows under Alternative 1C would be identical to those described for Impact SW 3 under Alternative 1A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Alternative 1C would provide benefits related to reducing reverse flows in Old and Middle Rivers in June through March and adverse impacts in increased reverse flow conditions in April and May as compared to existing conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Effects on alteration of existing drainage patterns under Alternative 1C would be similar to those described for Impact SW 4 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects on drainage patterns would be the same. Due to the construction of canals under Alternative 1C as compared to tunnels, the potential for interruption of existing drainage facilities would be higher. However, the same types of activities related to installation of temporary and permanent drainage facilities and restoration of disturbed drainage facilities would occur under Alternative 1C as under Alternative 1A, as described in the Chapter 3, Description of Alternatives.

In total, Alternative 1C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

***CEQA Conclusion*:** In total, Alternative 1C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects on surface waters due to runoff under Alternative 1C would be similar to those described for Impact SW 5 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects on surface waters would be the same. Due to the construction of canals under Alternative 1C as compared to tunnels, groundwater dewatering would over a larger area and the amount of dewatering would be increased because canals would require more dewatering activities than tunneling operations that can occur in high groundwater conditions.

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However, the same types of activities related to installation of temporary and permanent drainage facilities would occur under Alternative 1C as under Alternative 1A, as described in the Chapter 3, Description of Alternatives.

Alternative 1C actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 1C would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

***CEQA Conclusion*:** Alternative 1C actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 1C would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

Increased exposure of people or structures to flood risks under Alternative 1C would be similar to those described for Impact SW-6 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects related to flood potential would be the same and the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

***CEQA Conclusion*:** Alternative 1C would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW-6 in the discussion of Impact SW-6 under Alternative 1A.

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject to inundation by mudflow

Effects on flood potential would be similar under Alternative 1C to impacts described for Impact SW-7 under Alternative 1A because facilities would be designed to avoid increased flood potential as

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compared to existing conditions or No Action Alternative in accordance with the requirements of the USACE, CVFPB, and DWR. As described under Impact SW 4, Alternative 1C would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW 2. Alternative 1C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

***CEQA Conclusion*:** Alternative 1C would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

6.3.3.5 Alternative 2A—Dual Conveyance with Tunnel and Five Intakes (15,000 cfs; Operational Scenario B)

Facilities construction under Alternative 2A would be identical to those described for Alternative 1A. Alternative 2A could involved relocation of two of the intakes to a location south of the confluence of Sutter and Steamboat sloughs and the Sacramento River.

Operations under Alternative 2A would be similar as under Alternative 1A except for the following actions.

- Alternative 2A would include operations to comply with Fall X2 criteria that will increase Delta outflow in September through November when the previous years were above normal and wet water years, as in the No Action Alternative.
- Alternative 2A would include operations to restrict use of the south Delta exports through specific criteria to reduce reverse flows in Old and Middle River to a greater extent than Alternative 1A. These criteria would reduce use of the south Delta intakes except in April and May as compared to the No Action Alternative.
- Alternative 2A would include operations of a removable barrier at the Head of Old River. Use of this barrier would increase reverse flows in Old and Middle Rivers in April and May because there would be less water available at these intakes from the San Joaquin River.
- Due to the restrictions on the use of south Delta intakes, more water would be diverted through the north Delta intakes from December through July in Alternative 2A as compared to Alternative 1A. This operation increases total export patterns in the spring months and

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decreases total exports in the fall months when north Delta intakes operations would be constrained by north Delta bypass flows, as described in Chapter 3, Description of Alternatives.

- Delta outflow increases in fall months in above normal and wet years to comply with Fall X2 criteria, but decreases in other months due to increased total exports as compared to No Action Alternative Late Long Term.
- Alternative 2A provides for more frequent spills into Yolo Bypass at Fremont Weir to increase frequency and extent of inundation.

Impact SW‑1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Under Alternative 2A, reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and No Action Alternative, as shown in Figures 6‑10 through 6‑13. These differences represent changes under Alternative 2A and changes due to sea level rise and climate change.

Changes due to sea level rise and climate change are indicated through the comparison of or reservoir storage under No Action Alternative Late Long‑Term as compared to reservoir storage under No Action Alternative. Reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6‑10 through 6‑13, due to sea level rise and climate change.

Reservoir storages in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake at the end of May under Alternative 2A would be equal to or less than reservoir storage under No Action Late Long‑Term, as described in Section 6.4, Cumulative Analysis. The reduction in reservoir storage at the end of May would occur because additional water would be diverted at the north Delta intakes under Alternative 2A in the spring months as compared to the No Action Alternative. The reduced storage volumes would allow for storage of additional runoff that could reduce the potential for flooding downstream of the reservoirs. The effect would be beneficial related to flood management.

CEQA Conclusion: Alternative 2A would increase the ability to store runoff in the spring in the upper Sacramento River watershed, and therefore, could reduce the potential for flooding downstream of the reservoirs. Therefore, Alternative 2A would result in a less than significant impact on flood management.

Impact SW‑2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Sacramento River at Freeport

Under Alternative 2A, high monthly flows in the Sacramento River at Freeport in February under would be about 2% higher than flows under existing conditions and lower than flows under No Action Alternative, as shown in Figure 6‑14. However, these differences represent changes under Alternative 2A and changes due to sea level rise and climate change.

High monthly flows in wet years in the Sacramento River at Freeport in February under No Action Alternative Late Long‑Term would be about 5% higher than under No Action Alternative, as shown in Figure 6‑14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport.

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High monthly flows in wet years in the Sacramento River at Freeport in February under Alternative 2A would be lower than under No Action Alternative Late Long Term, as shown in Figure 6-14. On a monthly basis, flood potential at these locations would not change under Alternative 2A as compared to No Action Alternative Late Long Term. Therefore, Alternative 2A would result in a beneficial impact on flood management.

San Joaquin River at Vernalis

Under Alternative 2A, high monthly flows in the San Joaquin River at Vernalis in March in wet years would be about 5% higher than flows under existing conditions and about 6% higher under No Action Alternative, as shown in Figure 6-16. These differences represent changes under Alternative 2A and changes due to sea level rise and climate change.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under No Action Alternative Late Long Term would be about 6% higher than under No Action Alternative, as shown in Figure 6-14. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternative 2A would be equal to flows under No Action Alternative Late Long Term, as shown in Figure 6-14. On a monthly basis, flood potential at these locations would not change under Alternative 2A as compared to No Action Alternative Late Long Term. Therefore, Alternative 2A would result in no impact on flood management.

Sacramento River at Locations Upstream of Walnut Grove

Under Alternative 2A, high monthly flows in the Sacramento River downstream of the north Delta intakes in February would be less than under existing conditions and No Action Alternative, as shown in Figure 6-18. A portion of the reduction in flows would be due to climate change, especially in April through September when the flows under the No Action Alternative Late Long Term would be less than flows under No Action Alternative. However, flows downstream of the north Delta intakes would be reduced in all months on a long-term average due to the operations of the north Delta intakes.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6-18.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternative 2A would be less than flows under No Action Alternative Late Long Term, as shown in Figure 6-18. On a monthly basis, flood potential at these locations would not change under Alternative 2A as compared to No Action Alternative Late Long Term. Therefore, Alternative 2A would result in a beneficial impact on flood management.

Trinity River Downstream of Lewiston Dam

Under Alternative 2A, high monthly flows in Trinity River downstream of Lewiston Lake in May in wet years would be similar to flows under existing conditions and No Action Alternative for, as shown in Figure 6-20.

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High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under No Action Alternative Late Long Term would be similar to flows under No Action Alternative, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under Alternative 2A would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 20. On a monthly basis, flood potential at these locations would not change under Alternative 2A as compared to No Action Alternative Late Long Term. Therefore, Alternative 2A would result in no impact on flood management.

American River Downstream of Nimbus Dam

Under Alternative 2A, high monthly flows in the American River at Nimbus Dam in January and February in wet years under Alternative 2A would be 20 to 30% higher than flows under existing conditions and No Action Alternative, as shown in Figure 6 22. These differences represent changes under Alternative 2A and changes due to sea level rise and climate change.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under No Action Alternative Late Long Term would be 20 to 30% higher than under No Action Alternative, as shown in Figure 6 22.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under Alternative 2A would be similar under No Action Alternative Late Long Term, as shown in Figure 6 22. On a monthly basis, flood potential at these locations would not change under Alternative 2A as compared to No Action Alternative Late Long Term. Therefore, Alternative 2A would result in no impact on flood management.

Feather River Downstream of Thermalito Dam

Under Alternative 2A, high monthly flows in wet years in the Feather River at Thermalito Dam in February would be 42% higher than flows under existing conditions and 39% higher than flows under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24. A portion of the changes would be related to climate change.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24 would not exceed channel capacity of 150,000 cfs in this location.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternative 2A would be 8% higher than under No Action Alternative Late Long Term because water is released from Lake Oroville for diversions at the north Delta intakes in the winter months, as described in Chapter 5, Water Supply. However, the average monthly flows in the high monthly flows would not exceed channel capacity of 150,000 cfs in this location. Therefore, Alternative 2A would not result in an adverse impact on flood management.

Yolo Bypass at Fremont Weir

Under Alternative 2A, peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years would be 35% higher than peak monthly spills under existing conditions and 38% higher than

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spills under No Action Alternative, as shown in Figure 6 26. A portion of the changes would be related to climate change.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 26.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternative 2A would be 5% higher than under No Action Alternative Late Long Term, as shown in Figure 6 26, because Alternative 2A operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass. as compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir. Therefore, Alternative 2A would not result in an adverse impact on flood management.

Overall, Alternative 2A would not result in an increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 2A in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 2A would not result in adverse impacts on flood management.

CEQA Conclusion: Alternative 2A would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 2A in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 2A would result in a less than significant impact on flood management.

Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be less likely under Alternative 2A on a long term average basis except in April as compared to reverse flows under existing conditions and No Action Alternative, as shown in Figure 6 27. Therefore, Alternative 2A would result in beneficial impacts toward reductions in reverse flow conditions in Old and Middle Rivers in May through March and adverse impacts with increased reverse flow conditions in April.

Reverse flow conditions in Old and Middle Rivers would be affected by sea level rise and climate change. Under the No Action Alternative Late Long Term Reverse flow conditions for Old and Middle River flows would be less likely to occur on a long term average basis except in April and May as compared to reverse flows under No Action Alternative, as shown in Figure 6 27.

Reverse flow conditions under Alternative 2A would be less likely to occur on a long term average basis except in April as compared to No Action Alternative Late Long Term.

CEQA Conclusion: Alternative 2A would provide benefits related to reducing reverse flows in Old and Middle Rivers in May through March and adverse impacts in increased reverse flow conditions in April as compared to existing conditions. Determination of the significance of this effect is related

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to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Effects associated with construction and operations of facilities under Alternative 2A would be identical to those described under Alternative 1A because the facilities would be identical.

In total, Alternative 2A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 2A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects associated with construction and operations of facilities under Alternative 2A would be identical to those described under Alternative 1A because the facilities would be identical. Alternative 2A actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 2A would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 2A actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 2A would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

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Impact SW-6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

Impacts associated with construction and operations of facilities under Alternative 2A would be identical to those described under Alternative 1A because the facilities would be identical. Alternative 2A would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 2A would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW-6 in the discussion of Impact SW-6 under Alternative 1A.

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject to inundation by mudflow

Impacts associated with construction and operations of facilities under Alternative 2A would be identical to those described under Alternative 1A because the facilities would be identical. As described under Impact SW-4, Alternative 2A would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 2A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 2A would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4.

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6.3.3.6 Alternative 2B—Dual Conveyance with East Canal and Five Intakes (15,000 cfs; Operational Scenario B)

Facilities construction under Alternative 2B would be identical to those described for Alternative 1B. Alternative 2B could involved relocation of two of the intakes to a location south of the confluence of Sutter and Steamboat sloughs and the Sacramento River.

Operations of the facilities and implementation of the conservation measures under Alternative 2B would be identical to actions described under Alternative 2A.

Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Effects on SWP and CVP reservoir storage under Alternative 2B would be identical to those described for Impact SW 1 under Alternative 2A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on SWP and CVP reservoir storage under Alternative 2B would be identical to those described under Alternative 2A because the operations of the facilities would be identical. Therefore, Alternative 2B would result in a less than significant impact on flood management.

Impact SW 2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Effects on surface water flows under Alternative 2B would be identical to those described for Impact SW 2 under Alternative 2A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on surface water flows under Alternative 2B would be identical to those described under Alternative 2A because the operations of the facilities would be identical. Therefore, Alternative 2A would result in less than significant river flow impacts on flood management.

Impact SW 3. Substantial increase in reverse flow conditions in Old and Middle Rivers

Effects on Old and Middle River flows under Alternative 2B would be identical to those described for Impact SW 3 under Alternative 2A because the operations of the facilities would be identical.

CEQA Conclusion: Alternative 2B would provide benefits related to reducing reverse flows in Old and Middle Rivers in May through March and adverse impacts in increased reverse flow conditions in April as compared to existing conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Effects associated with construction and operations of facilities under Alternative 2B would be identical to those described under Alternative 1B because the facilities would be identical.

In total, Alternative 2B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in

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the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 2B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential significant impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects associated with construction and operations of facilities under Alternative 2B would be identical to those described under Alternative 1B because the facilities would be identical.

Alternative 2B actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 2B would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 2B actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 2B would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

Impacts associated with construction and operations of facilities under Alternative 2B would be identical to those described under Alternative 1B because the facilities would be identical. Alternative 2B would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE,

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CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 2B would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW-6 in the discussion of Impact SW-6 under Alternative 1A.

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject to inundation by mudflow

Impacts associated with construction and operations of facilities under Alternative 2B would be identical to those described under Alternative 1B because the facilities would be identical. As described under Impact SW-1, Alternative 2B would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 2B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 2B would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4.

6.3.3.7 Alternative 2C—Dual Conveyance with West Canal and Intakes W1–W5 (15,000 cfs; Operational Scenario B)

Facilities construction under Alternative 2C would be identical to those described for Alternative 1C. Alternative 2C could involved relocation of two of the intakes to a location south of the confluence of Sutter and Steamboat sloughs and the Sacramento River. Operations would be different under

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Alternative 2C than Alternative 1C and would be reflected in changes in agricultural and regional economics for Upstream of the Delta and Export Service Area.

Operations of the facilities and implementation of the conservation measures under Alternative 2C would be identical to actions described under Alternative 2A.

Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Effects on SWP and CVP reservoir storage under Alternative 2C would be identical to those described for Impact SW 1 under Alternative 2A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on SWP and CVP reservoir storage under Alternative 2C would be identical to those described under Alternative 2A because the operations of the facilities would be identical. Therefore, Alternative 2B would result in a less than significant impact on flood management.

Impact SW 2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Effects on surface water flows under Alternative 2C would be identical to those described for Impact SW 2 under Alternative 2A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on surface water flows under Alternative 2C would be identical to those described under Alternative 2A because the operations of the facilities would be identical. Therefore, Alternative 2A would result in less than significant river flow impacts on flood management.

Impact SW 3. Substantial increase in reverse flow conditions in Old and Middle Rivers

Effects on Old and Middle River flows under Alternative 2C would be identical to those described for Impact SW 3 under Alternative 2A because the operations of the facilities would be identical.

CEQA Conclusion: Alternative 2C would provide benefits related to reducing reverse flows in Old and Middle Rivers in May through March and adverse impacts in increased reverse flow conditions in April as compared to existing conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Impacts associated with construction and operations of facilities under Alternative 2C would be identical to those described under Alternative 1C because the facilities would be identical.

In total, Alternative 2C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

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CEQA Conclusion: In total, Alternative 2C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential significant impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-5. Creation or contribution of runoff water from a constructed facility which would exceed the capacity of existing or planned stormwater drainage systems.

Effects associated with construction and operations of facilities under Alternative 2C would be identical to those described under Alternative 1C because the facilities would be identical.

Alternative 2C actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 1A would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 2C actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 2C would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

Effects associated with construction and operations of facilities under Alternative 2C would be identical to those described under Alternative 1C because the facilities would be identical. Alternative 2C would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. **CEQA Conclusion:** Alternative 2C would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration

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facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW-6 in the discussion of Impact SW-6 under Alternative 1A.

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject to inundation by mudflow

Impacts associated with construction and operations of facilities under Alternative 2C would be identical to those described under Alternative 1C because the facilities would be identical. As described under Impact SW-1, Alternative 2C would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 2C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 2C would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4.

6.3.3.8 Alternative 3—Dual Conveyance with Tunnel and Intakes 1 and 2 (6,000 cfs; Operational Scenario A)

Facilities construction under Alternative 3 would be similar to those described for Alternative 1A with only two intakes.

Operations under Alternative 3 would be identical as under Alternative 1A except that there would be more reliance on the south Delta intakes due to less capacity provided by the north Delta intakes.

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Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Under Alternative 3, reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville , and Folsom Lake would be less than under existing conditions and No Action Alternative, as shown in Figures 6 10 through 6 13. The differences between storage under Alternative 3 and existing conditions and No Action Alternative represent changes under Alternative 3 and changes due to sea level rise and climate change.

Changes due to sea level rise and climate change are indicated through the comparison of or reservoir storage under No Action Alternative Late Long Term as compared to reservoir storage under No Action Alternative. Reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6 10 through 6 13, due to sea level rise and climate change.

Reservoir storages in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake at the end of May under Alternative 3 would be equal to or less than reservoir storage under No Action Late Long Term, as described in Section 6.4, Cumulative Analysis. The reduction in reservoir storage at the end of May would occur because additional water would be diverted at the north Delta intakes under Alternative 3 in the spring months as compared to the No Action Alternative. The reduced storage volumes would allow for storage of additional runoff that could reduce the potential for flooding downstream of the reservoirs. The effect would be beneficial related to flood management.

CEQA Conclusion: Alternative 3 would increase the ability to store runoff in the spring in the upper Sacramento River watershed, and therefore, could reduce the potential for flooding downstream of the reservoirs. Therefore, Alternative 2B would result in a less than significant impact on flood management.

Impact SW 2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Sacramento River at Freeport

Under Alternative 3, high monthly flows in the Sacramento River at Freeport in February under would be about 2% higher than flows under existing conditions and about 3% higher than flows under No Action Alternative, as shown in Figure 6 14. However, these differences represent changes under Alternative 3 and changes due to sea level rise and climate change.

High monthly flows in wet years in the Sacramento River at Freeport in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6 14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport.

High monthly flows in wet years in the Sacramento River at Freeport in February under Alternative 3 would be lower than under No Action Alternative Late Long Term, as shown in Figure 6 14. On a monthly basis, flood potential at these locations would not change under Alternative 3 as compared to No Action Alternative Late Long Term. Therefore, Alternative 3 would result in a beneficial impact on flood management.

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San Joaquin River at Vernalis

Under Alternative 3, high monthly flows in the San Joaquin River at Vernalis in March in wet years would be about 5% higher than flows under existing conditions and about 6% higher under No Action Alternative, as shown in Figure 6 16. These differences represent changes under Alternative 3 and changes due to sea level rise and climate change.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under No Action Alternative Late Long Term would be about 6% higher than under No Action Alternative, as shown in Figure 6 14. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternative 3 would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 14. On a monthly basis, flood potential at these locations would not change under Alternative 3 as compared to No Action Alternative Late Long Term. Therefore, Alternative 3 would result in no impact on flood management.

Sacramento River at Locations Upstream of Walnut Grove

Under Alternative 3, high monthly flows in the Sacramento River downstream of the north Delta intakes in February would be less than under existing conditions and No Action Alternative, as shown in Figure 6 18. A portion of the reduction in flows would be due to climate change, especially in April through September when the flows under the No Action Alternative Late Long Term would be less than flows under No Action Alternative. However, flows downstream of the north Delta intakes would be reduced in all months on a long term average due to the operations of the north Delta intakes.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6 18.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternative 3 would be less than flows under No Action Alternative Late Long Term, as shown in Figure 6 18. On a monthly basis, flood potential at these locations would not change under Alternative 3 as compared to No Action Alternative Late Long Term. Therefore, Alternative 3 would result in a beneficial impact on flood management.

Trinity River Downstream of Lewiston Dam

Under Alternative 3, high monthly flows in Trinity River downstream of Lewiston Lake in May in wet years would be similar to flows under existing conditions and No Action Alternative for, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under No Action Alternative Late Long Term would be similar to flows under No Action Alternative, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under Alternative 3 would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 20. On a monthly basis, flood potential at these locations would not change under

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Alternative 3 as compared to No Action Alternative Late Long Term. Therefore, Alternative 3 would result in no impact on flood management.

American River Downstream of Nimbus Dam

Under Alternative 3, high monthly flows in the American River at Nimbus Dam in January and February in wet years under Alternative 3 would be 20 to 30% higher than flows under existing conditions and No Action Alternative, as shown in Figure 6 22. These differences represent changes under Alternative 3 and changes due to sea level rise and climate change.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under No Action Alternative Late Long Term would be 20 to 30% higher than under No Action Alternative, as shown in Figure 6 22.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under Alternative 3 would be lower than under No Action Alternative Late Long Term, as shown in Figure 6 22. On a monthly basis, flood potential at these locations would not change under Alternative 3 as compared to No Action Alternative Late Long Term. Therefore, Alternative 3 would result in no impact on flood management.

Feather River Downstream of Thermalito Dam

Under Alternative 3, high monthly flows in wet years in the Feather River at Thermalito Dam in February would be 32% higher than flows under existing conditions and 43% higher than flows under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24. A portion of the changes would be related to climate change.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24 would not exceed channel capacity of 150,000 cfs in this location.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternative 3 would be 12% higher than under No Action Alternative Late Long Term because water is released from Lake Oroville for diversions at the north Delta intakes in the winter months, as described in Chapter 5, Water Supply. However, the average monthly flows in the high monthly flows would not exceed channel capacity of 150,000 cfs in this location. Therefore, Alternative 3 would not result in an adverse impact on flood management.

Yolo Bypass at Fremont Weir

Under Alternative 3, peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years would be 38% higher than peak monthly spills under existing conditions and 41% higher than spills under No Action Alternative, as shown in Figure 6 26. A portion of the changes would be related to climate change.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 26.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternative 3 would be 10% higher than under No Action Alternative Late Long Term, as shown in

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Figure 6 26, because Alternative 3 operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass. as compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir. Therefore, Alternative 3 would not result in an adverse impact on flood management.

Overall, Alternative 3 would not result in an increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 3 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 3 would not result in adverse impacts on flood management.

***CEQA Conclusion*:** Alternative 3 would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 3 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 3 would result in a less than significant impact on flood management.

Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be less likely under Alternative 3 on a long term average basis except in April and May as compared to reverse flows under existing conditions and No Action Alternative, as shown in Figure 6 27. Therefore, Alternative 3 would result in beneficial impacts toward reductions in reverse flow conditions in Old and Middle Rivers in June through March and adverse impacts with increased reverse flow conditions in April.

Reverse flow conditions in Old and Middle Rivers would be affected by sea level rise and climate change. Under the No Action Alternative Late Long Term Reverse flow conditions for Old and Middle River flows would be less likely to occur on a long term average basis except in April and May as compared to reverse flows under No Action Alternative, as shown in Figure 6 27.

Reverse flow conditions under Alternative 3 would be less likely to occur on a long term average basis except in January, April, and May as compared to No Action Alternative Late Long Term.

***CEQA Conclusion*:** Alternative 3 would provide benefits related to reducing reverse flows in Old and Middle Rivers in June through March and adverse impacts in increased reverse flow conditions in April and May as compared to existing conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Impacts associated with construction and operations of facilities under Alternative 3 would be identical those described under Alternative 1A because the facilities would be identical with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 3.

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In total, Alternative 3 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 3 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential significant impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects associated with construction and operations of facilities under Alternative 3 would be identical those described under Alternative 1A because the facilities would be identical with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A.

Alternative 3 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 3 would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 3 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 3 would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

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Impact SW-6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

Effects associated with construction and operations of facilities under Alternative 3 would be identical those described under Alternative 1A because the facilities would be identical with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 3. Therefore, Alternative 3 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 3 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW-6 in the discussion of Impact SW-6 under Alternative 1A. .

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject inundation by mudflow.

Effects associated with construction and operations of facilities under Alternative 3 would be identical those described under Alternative 1A because the facilities would be identical with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 3. As described under Impact SW-1, Alternative 3 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 3 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 3 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near

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the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

6.3.3.9 Alternative 4—Dual Conveyance with Tunnel and Intakes 1–3 (9,000 cfs; Operational Scenario B)

Facilities construction under Alternative 4 would be similar to those described for Alternative 1A with only three intakes.

Operations under Alternative 4 would be identical as under Alternative 2A except that there would be more reliance on the south Delta intakes due to less capacity provided by the north Delta intakes.

Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Under Alternative 4, reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and No Action Alternative, as shown in Figures 6 10 through 6 13. These differences represent changes under Alternative 4 and changes due to sea level rise and climate change.

Changes due to sea level rise and climate change are indicated through the comparison of or reservoir storage under No Action Alternative Late Long Term as compared to reservoir storage under No Action Alternative. Reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6 10 through 6 13, due to sea level rise and climate change.

Reservoir storages in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake at the end of May under Alternative 4 would be equal to or less than reservoir storage under No Action Late Long Term, as described in Section 6.4, Cumulative Analysis. The reduction in reservoir storage at the end of May would occur because additional water would be diverted at the north Delta intakes under Alternative 4 in the spring months as compared to the No Action Alternative. The reduced storage volumes would allow for storage of additional runoff that could reduce the potential for flooding downstream of the reservoirs. The effect would be beneficial related to flood management.

CEQA Conclusion: Alternative 4 would increase the ability to store runoff in the spring in the upper Sacramento River watershed, and therefore, could reduce the potential for flooding downstream of the reservoirs. Therefore, Alternative 4 would result in a less than significant impact on flood management.

Impact SW 2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Sacramento River at Freeport

Under Alternative 4, high monthly flows in the Sacramento River at Freeport in February under would be about 2% higher than flows under existing conditions and 3% higher than flows under No

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Action Alternative, as shown in Figure 6-14. However, these differences represent changes under Alternative 4 and changes due to sea level rise and climate change.

High monthly flows in wet years in the Sacramento River at Freeport in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6-14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport.

High monthly flows in wet years in the Sacramento River at Freeport in February under Alternative 4 would be lower than under No Action Alternative Late Long Term, as shown in Figure 6-14. On a monthly basis, flood potential at these locations would not change under Alternative 4 as compared to No Action Alternative Late Long Term. Therefore, Alternative 4 would result in a beneficial impact on flood management.

San Joaquin River at Vernalis

Under Alternative 4, high monthly flows in the San Joaquin River at Vernalis in March in wet years would be about 10% higher than flows under existing conditions and about 6% higher under No Action Alternative, as shown in Figure 6-16. These differences represent changes under Alternative 4 and changes due to sea level rise and climate change.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under No Action Alternative Late Long Term would be about 6% higher than under No Action Alternative, as shown in Figure 6-14. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternative 4 would be equal to flows under No Action Alternative Late Long Term, as shown in Figure 6-14. On a monthly basis, flood potential at these locations would not change under Alternative 4 as compared to No Action Alternative Late Long Term. Therefore, Alternative 4 would result in no impact on flood management.

Sacramento River at Locations Upstream of Walnut Grove

Under Alternative 4, high monthly flows in the Sacramento River downstream of the north Delta intakes in February would be less than under existing conditions and No Action Alternative, as shown in Figure 6-18. A portion of the reduction in flows would be due to climate change, especially in April through September when the flows under the No Action Alternative Late Long Term would be less than flows under No Action Alternative. However, flows downstream of the north Delta intakes would be reduced in all months on a long-term average due to the operations of the north Delta intakes.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6-18.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternative 4 would be less than flows under No Action Alternative Late Long Term, as shown in Figure 6-18. On a monthly basis, flood potential at these locations would not change under Alternative 4 as compared to No Action Alternative Late Long Term. Therefore, Alternative 4 would result in a beneficial impact on flood management.

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Trinity River Downstream of Lewiston Dam

Under Alternative 4, high monthly flows in Trinity River downstream of Lewiston Lake in May in wet years would be similar to flows under existing conditions and No Action Alternative for, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under No Action Alternative Late Long Term would be similar to flows under No Action Alternative, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under Alternative 4 would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 20. On a monthly basis, flood potential at these locations would not change under Alternative 4 as compared to No Action Alternative Late Long Term. Therefore, Alternative 4 would result in no impact on flood management.

American River Downstream of Nimbus Dam

Under Alternative 4, high monthly flows in the American River at Nimbus Dam in January and February in wet years under Alternative 4 would be 20 to 30% higher than flows under existing conditions and No Action Alternative, as shown in Figure 6 22. These differences represent changes under Alternative 4 and changes due to sea level rise and climate change.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under No Action Alternative Late Long Term would be 20 to 30% higher than under No Action Alternative, as shown in Figure 6 22.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under Alternative 4 would be similar under No Action Alternative Late Long Term, as shown in Figure 6 22. On a monthly basis, flood potential at these locations would not change under Alternative 4 as compared to No Action Alternative Late Long Term. Therefore, Alternative 4 would result in no impact on flood management.

Feather River Downstream of Thermalito Dam

Under Alternative 4, high monthly flows in wet years in the Feather River at Thermalito Dam in February would be 31% higher than flows under existing conditions and 41% higher than flows under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24. A portion of the changes would be related to climate change.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24 would not exceed channel capacity of 150,000 cfs in this location.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternative 4 would be 10% higher than under No Action Alternative Late Long Term because water is released from Lake Oroville for diversions at the north Delta intakes in the winter months, as described in Chapter 5, Water Supply. However, the average monthly flows in the high monthly flows would not exceed channel capacity of 150,000 cfs in this location. Therefore, Alternative 4 would not result in an adverse impact on flood management.

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Yolo Bypass at Fremont Weir

Under Alternative 4, peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years would be 36% higher than peak monthly spills under existing conditions and 39% higher than spills under No Action Alternative, as shown in Figure 6 26. A portion of the changes would be related to climate change.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 26.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternative 4 would be 8% higher than under No Action Alternative Late Long Term, as shown in Figure 6 26, because Alternative 4 operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass. as compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir. Therefore, Alternative 4 would not result in an adverse impact on flood management.

Overall, Alternative 4 would not result in an increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 4 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 4 would not result in adverse impacts on flood management.

CEQA Conclusion: Alternative 4 would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 4 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 4 would result in a less than significant impact on flood management.

Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be less likely under Alternative 4 on a long term average basis except in April and May as compared to reverse flows under existing conditions and No Action Alternative, as shown in Figure 6 27. Therefore, Alternative 4 would result in beneficial impacts toward reductions in reverse flow conditions in Old and Middle Rivers in June through March and adverse impacts with increased reverse flow conditions in April.

Reverse flow conditions in Old and Middle Rivers would be affected by sea level rise and climate change. Under the No Action Alternative Late Long Term Reverse flow conditions for Old and Middle River flows would be less likely to occur on a long term average basis except in April and May as compared to reverse flows under No Action Alternative, as shown in Figure 6 27.

Reverse flow conditions under Alternative 4 would be less likely to occur on a long term average basis except in April and May as compared to No Action Alternative Late Long Term.

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CEQA Conclusion: Alternative 4 would provide benefits related to reducing reverse flows in Old and Middle Rivers in June through March and adverse impacts in increased reverse flow conditions in April and May as compared to existing conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Impacts associated with construction and operations of facilities under Alternative 4 would be identical those described under Alternative 1A because the facilities would be identical with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 4.

In total, Alternative 4 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 4 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential significant impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects associated with construction and operations of facilities under Alternative 4 would be identical those described under Alternative 1A because the facilities would be identical with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A.

Alternative 4 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 4 would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 4 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB.

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Alternative 4 would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

Effects associated with construction and operations of facilities under Alternative 4 would be identical those described under Alternative 1A because the facilities would be identical with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 4. Therefore, Alternative 3 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 4 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW 6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW 6 in the discussion of Impact SW 6 under Alternative 1A.

Impact SW 7. Construction of a facility within a 100 year flood hazard area that would impede or redirect flood flows, or be subject inundation by mudflow

Effects associated with construction and operations of facilities under Alternative 4 would be identical those described under Alternative 1A because the facilities would be identical with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 4. As described under Impact SW 1, Alternative 4 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW 2. Alternative 4 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts

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could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 4 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

6.3.3.10 Alternative 5—Dual Conveyance with Tunnel and Intake 1 (3,000 cfs; Operational Scenario C)

Facilities construction under Alternative 5 would be similar to those described for Alternative 1A with only one intake.

Operations under Alternative 5 would be similar as under Alternative 1A except for the following actions.

- Alternative 5 would include operations to comply with Fall X2 criteria that will increase Delta outflow in September through November when the previous years were above normal and wet water years, as in the No Action Alternative.
- Alternative 5 would include operations to restrict use of the south Delta exports through specific criteria related to the San Joaquin River inflow/export ratio.
- Alternative 5 also provides for more frequent spills into Yolo Bypass at Fremont Weir to increase frequency and extent of inundation.

Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Under Alternative 5 reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and No Action Alternative, as shown in Figures 6 10 through 6 13. These differences represent changes under Alternative 5 and changes due to sea level rise and climate change.

Changes due to sea level rise and climate change are indicated through the comparison of or reservoir storage under No Action Alternative Late Long Term as compared to reservoir storage under No Action Alternative. Reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6 10 through 6 13, due to sea level rise and climate change.

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Reservoir storages in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake at the end of May under Alternative 5 would be equal to or less than reservoir storage under No Action Late Long-Term, as described in Section 6.4, Cumulative Analysis. The reduced storage volumes would allow for storage of additional runoff that could reduce the potential for flooding downstream of the reservoirs. The effect would be beneficial related to flood management.

CEQA Conclusion: Alternative 5 would increase the ability to store runoff in the spring in the upper Sacramento River watershed, and therefore, could reduce the potential for flooding downstream of the reservoirs. Therefore, Alternative 5 would result in a less than significant impact on flood management.

Impact SW-2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Sacramento River at Freeport

Under Alternative 5, high monthly flows in the Sacramento River at Freeport in February under would be about 2% higher than flows under existing conditions and 3% higher than flows under No Action Alternative, as shown in Figure 6-14. However, these differences represent changes under Alternative 5 and changes due to sea level rise and climate change.

High monthly flows in wet years in the Sacramento River at Freeport in February under No Action Alternative Late Long-Term would be about 5% higher than under No Action Alternative, as shown in Figure 6-14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport.

High monthly flows in wet years in the Sacramento River at Freeport in February under Alternative 5 would be lower than under No Action Alternative Late Long-Term, as shown in Figure 6-14. On a monthly basis, flood potential at these locations would not change under Alternative 5 as compared to No Action Alternative Late Long-Term. Therefore, Alternative 5 would result in a beneficial impact on flood management.

San Joaquin River at Vernalis

Under Alternative 5, high monthly flows in the San Joaquin River at Vernalis in March in wet years would be about 5% higher than flows under existing conditions and about 6% higher under No Action Alternative, as shown in Figure 6-16. These differences represent changes under Alternative 5 and changes due to sea level rise and climate change.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under No Action Alternative Late Long-Term would be about 6% higher than under No Action Alternative, as shown in Figure 6-14. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternative 5 would be similar to flows under No Action Alternative Late Long-Term, as shown in Figure 6-14. On a monthly basis, flood potential at these locations would not change under Alternative 5 as compared to No Action Alternative Late Long-Term. Therefore, Alternative 5 would result in no impact on flood management.

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Sacramento River at Locations Upstream of Walnut Grove

Under Alternative 5, high monthly flows in the Sacramento River downstream of the north Delta intakes in February would be less than under existing conditions and No Action Alternative, as shown in Figure 6 18. A portion of the reduction in flows would be due to climate change, especially in April through September when the flows under the No Action Alternative Late Long Term would be less than flows under No Action Alternative. However, flows downstream of the north Delta intakes would be reduced in all months on a long term average due to the operations of the north Delta intakes.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6 18.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternative 5 would be less than flows under No Action Alternative Late Long Term, as shown in Figure 6 18. On a monthly basis, flood potential at these locations would not change under Alternative 5 as compared to No Action Alternative Late Long Term. Therefore, Alternative 5 would result in a beneficial impact on flood management.

Trinity River Downstream of Lewiston Dam

Under Alternative 5, high monthly flows in Trinity River downstream of Lewiston Lake in May in wet years would be similar to flows under existing conditions and No Action Alternative for, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under No Action Alternative Late Long Term would be similar to flows under No Action Alternative, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under Alternative 5 would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 20. On a monthly basis, flood potential at these locations would not change under Alternative 5 as compared to No Action Alternative Late Long Term. Therefore, Alternative 5 would result in no impact on flood management.

American River Downstream of Nimbus Dam

Under Alternative 5, high monthly flows in the American River at Nimbus Dam in January and February in wet years under Alternative 5 would be 20 to 30% higher than flows under existing conditions and No Action Alternative, as shown in Figure 6 22. These differences represent changes under Alternative 5 and changes due to sea level rise and climate change.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under No Action Alternative Late Long Term would be 20 to 30% higher than under No Action Alternative, as shown in Figure 6 22.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under Alternative 5 would be similar under No Action Alternative Late Long Term, as shown in Figure 6 22. On a monthly basis, flood potential at these locations would not change under Alternative 5 as compared to No Action Alternative Late Long Term. Therefore, Alternative 5 would result in no impact on flood management.

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Feather River Downstream of Thermalito Dam

Under Alternative 5, high monthly flows in wet years in the Feather River at Thermalito Dam in February would be 30% higher than flows under existing conditions and 41% higher than flows under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24. A portion of the changes would be related to climate change.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24 would not exceed channel capacity of 150,000 cfs in this location.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternative 5 would be 10% higher than under No Action Alternative Late Long Term because water is released from Lake Oroville for diversions at the north Delta intakes in the winter months, as described in Chapter 5, Water Supply. However, the average monthly flows in the high monthly flows would not exceed channel capacity of 150,000 cfs in this location. Therefore, Alternative 5 would not result in an adverse impact on flood management.

Yolo Bypass at Fremont Weir

Under Alternative 5, peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years would be 28% higher than peak monthly spills under existing conditions and 38% higher than spills under No Action Alternative, as shown in Figure 6 26. A portion of the changes would be related to climate change.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 26.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternative 5 would be 11% higher than under No Action Alternative Late Long Term, as shown in Figure 6 26, because Alternative 5 operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass. as compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir. Therefore, Alternative 5 would not result in an adverse impact on flood management.

Overall, Alternative 5 would not result in an increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 5 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 5 would not result in adverse impacts on flood management.

***CEQA Conclusion*:** Alternative 5 would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 5 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the

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increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 5 would result in a less than significant impact on flood management.

Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be less likely under Alternative 5 on a long term average basis except in April and May as compared to reverse flows under existing conditions and except in April as compared to No Action Alternative, as shown in Figure 6 27. Therefore, Alternative 5 would result in beneficial impacts toward reductions in reverse flow conditions in Old and Middle Rivers in June through March and adverse impacts with increased reverse flow conditions in April and May as compared to existing conditions. Alternative 5 would result in beneficial impacts toward reductions in reverse flow conditions in Old and Middle Rivers in May through March and adverse impacts with increased reverse flow conditions in April as compared to No Action Alternative.

Reverse flow conditions in Old and Middle Rivers would be affected by sea level rise and climate change. Under the No Action Alternative Late Long Term Reverse flow conditions for Old and Middle River flows would be less likely to occur on a long term average basis except in April and May as compared to reverse flows under No Action Alternative, as shown in Figure 6 27.

Reverse flow conditions under Alternative 5 would be less likely to occur on a long term average basis except in April and December as compared to No Action Alternative Late Long Term.

CEQA Conclusion: Alternative 5 would provide benefits related to reducing reverse flows in Old and Middle Rivers in June through March and adverse impacts in increased reverse flow conditions in April and May as compared to existing conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Impacts associated with construction and operations of facilities under Alternative 5 would be identical those described under Alternative 1A because the facilities would be identical with the exception of four fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 5.

In total, Alternative 5 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 5 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential significant impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near

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the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects associated with construction and operations of facilities under Alternative 5 would be identical those described under Alternative 1A because the facilities would be identical with the exception of four fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A.

Alternative 5 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 5 would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 5 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 5 would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

Effects associated with construction and operations of facilities under Alternative 5 would be identical those described under Alternative 1A because the facilities would be identical with the exception of four fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 5. Therefore, Alternative 5 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 5 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the

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habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW 6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW 6 in the discussion of Impact SW 6 under Alternative 1A.

Impact SW 7. Construction of a facility within a 100 year flood hazard area that would impede or redirect flood flows, or be subject inundation by mudflow

Effects associated with construction and operations of facilities under Alternative 5 would be identical those described under Alternative 1A because the facilities would be identical with the exception of four fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 5. As described under Impact SW 1, Alternative 5 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW 2. Alternative 5 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 5 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

6.3.3.11 Alternative 6A—Isolated Conveyance with Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario D)

Facilities construction under Alternative 6A would be similar to those described for Alternative 1A.

Operations under Alternative 6A would be identical as under Alternative 1A except that there would be more reliance on the north Delta intakes due to the elimination of the south Delta intakes; and Alternative 6A would include operations to comply with Fall X2 criteria, as in the No Action Alternative.

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Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Under Alternative 6A, reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and No Action Alternative, as shown in Figures 6 10 through 6 13, and similar to storage conditions described under Alternative 1A because the operational criteria would be the same in both alternatives. These differences represent changes under Alternative 6A and changes due to sea level rise and climate change.

Changes due to sea level rise and climate change are indicated through the comparison of or reservoir storage under No Action Alternative Late Long Term as compared to reservoir storage under No Action Alternative. Reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6 10 through 6 13, due to sea level rise and climate change.

Reservoir storages in Shasta Lake, Trinity Lake, and Lake Oroville at the end of May under Alternative 6A would be greater than reservoir storage under No Action Late Long Term, as described in Section 6.4, Cumulative Analysis. Reservoir storage in Folsom Lake at the end of May under Alternative 6A would be less than or no greater than 1% increase than reservoir storage under No Action Late Long Term, as described in Section 6.4, Cumulative Analysis. The reduced storage volumes would allow for storage of additional runoff that could reduce the potential for flooding downstream of the reservoirs. The effect would be beneficial related to flood management.

CEQA Conclusion: Alternative 6A would increase the ability to store runoff in the spring in the upper Sacramento River watershed, and therefore, could reduce the potential for flooding downstream of the reservoirs. Therefore, Alternative 6A would result in a less than significant impact on flood management.

Impact SW 2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Sacramento River at Freeport

Under Alternative 6A, high monthly flows in the Sacramento River at Freeport in February under would be about 2% higher than flows under existing conditions and 3% higher than flows under No Action Alternative, as shown in Figure 6 14. However, these differences represent changes under Alternative 6A and changes due to sea level rise and climate change.

High monthly flows in wet years in the Sacramento River at Freeport in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6 14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport.

High monthly flows in wet years in the Sacramento River at Freeport in February under Alternative 6A would be lower than under No Action Alternative Late Long Term, as shown in Figure 6 14. On a monthly basis, flood potential at these locations would not change under Alternative 6A as compared to No Action Alternative Late Long Term. Therefore, Alternative 6A would result in a beneficial impact on flood management.

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San Joaquin River at Vernalis

Under Alternative 6A, high monthly flows in the San Joaquin River at Vernalis in March in wet years would be about 9% higher than flows under existing conditions and about 6% higher under No Action Alternative, as shown in Figure 6 16. These differences represent changes under Alternative 6A and changes due to sea level rise and climate change.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under No Action Alternative Late Long Term would be about 6% higher than under No Action Alternative, as shown in Figure 6 14. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternative 6A would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 14. On a monthly basis, flood potential at these locations would not change under Alternative 6A as compared to No Action Alternative Late Long Term. Therefore, Alternative 6A would result in no impact on flood management.

Sacramento River at Locations Upstream of Walnut Grove

Under Alternative 6A, high monthly flows in the Sacramento River downstream of the north Delta intakes in February would be less than under existing conditions and No Action Alternative, as shown in Figure 6 18. A portion of the reduction in flows would be due to climate change, especially in April through September when the flows under the No Action Alternative Late Long Term would be less than flows under No Action Alternative. However, flows downstream of the north Delta intakes would be reduced in all months on a long term average due to the operations of the north Delta intakes.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6 18.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternative 6A would be less than flows under No Action Alternative Late Long Term, as shown in Figure 6 18. On a monthly basis, flood potential at these locations would not change under Alternative 6A as compared to No Action Alternative Late Long Term. Therefore, Alternative 6A would result in a beneficial impact on flood management.

Trinity River Downstream of Lewiston Dam

Under Alternative 6A, high monthly flows in Trinity River downstream of Lewiston Lake in May in wet years would be similar to flows under existing conditions and No Action Alternative for, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under No Action Alternative Late Long Term would be similar to flows under No Action Alternative, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under Alternative 6A would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 20. On a monthly basis, flood potential at these locations would not change under

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Alternative 6A as compared to No Action Alternative Late Long Term. Therefore, Alternative 6A would result in no impact on flood management.

American River Downstream of Nimbus Dam

Under Alternative 6A, high monthly flows in the American River at Nimbus Dam in January and February in wet years under Alternative 6A would be 20 to 30% higher than flows under existing conditions and No Action Alternative, as shown in Figure 6 22. These differences represent changes under Alternative 6A and changes due to sea level rise and climate change.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under No Action Alternative Late Long Term would be 20 to 30% higher than under No Action Alternative, as shown in Figure 6 22.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under Alternative 6A would be 1% higher than flows under No Action Alternative Late Long Term, or similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 22. On a monthly basis, flood potential at these locations would not be adverse under Alternative 6A as compared to No Action Alternative Late Long Term. Therefore, Alternative 6A would result in no impact on flood management.

Feather River Downstream of Thermalito Dam

Under Alternative 6A, high monthly flows in wet years in the Feather River at Thermalito Dam in February would be 29% higher than flows under existing conditions and 29% higher than flows under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24. A portion of the changes would be related to climate change.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24 would not exceed channel capacity of 150,000 cfs in this location.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternative 6A would be 8% higher than under No Action Alternative Late Long Term because water is released from Lake Oroville for diversions at the north Delta intakes in the winter months, as described in Chapter 5, Water Supply. However, the average monthly flows in the high monthly flows would not exceed channel capacity of 150,000 cfs in this location. Therefore, Alternative 6A would not result in an adverse impact on flood management.

Yolo Bypass at Fremont Weir

Under Alternative 6A, peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years would be 36% higher than peak monthly spills under existing conditions and 39% higher than spills under No Action Alternative, as shown in Figure 6 26. A portion of the changes would be related to climate change.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 26.

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High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternative 6A would be 9% higher than under No Action Alternative Late Long Term, as shown in Figure 6 26, because Alternative 6A operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass. as compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir. Therefore, Alternative 6A would not result in an adverse impact on flood management.

Overall, Alternative 6A would not result in an increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 6A in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 6A would not result in adverse impacts on flood management.

***CEQA Conclusion*:** Alternative 6A would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 6A in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 6A would result in a less than significant impact on flood management.

Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would not occur under Alternative 6A because there would be no exports from the south Delta intakes to cause reverse flow conditions. Therefore, Alternative 6A would result in a beneficial impact.

***CEQA Conclusion*:** Alternative 6A would provide benefits related to reducing reverse flows in Old and Middle Rivers in all months and the impacts would be less than significant.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Impacts associated with construction and operations of facilities under Alternative 6A would be identical to those described under Alternative 1A because the facilities would be identical.

In total, Alternative 6A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

***CEQA Conclusion*:** In total, Alternative 6A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential significant impacts

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could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects associated with construction and operations of facilities under Alternative 6A would be identical to those described under Alternative 1A because the facilities would be identical.

Alternative 6A actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 6A would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 6A actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 6A would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

Effects associated with construction and operations of facilities under Alternative 6A would be identical to those described under Alternative 1A because the facilities would be identical. Alternative 6A would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 6A would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent

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levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW-6 in the discussion of Impact SW-6 under Alternative 1A.

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject inundation by mudflow

Effects associated with construction and operations of facilities under Alternative 6A would be identical to those described under Alternative 1A because the facilities would be identical. As described under Impact SW-1, Alternative 6A would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 6A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 6A would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4.

6.3.3.12 Alternative 6B—Isolated Conveyance with East Canal and Intakes 1–5 (15,000 cfs; Operational Scenario D)

Facilities construction under Alternative 6B would be identical to those described for Alternative 1B.

Operations of the facilities and implementation of the conservation measures under Alternative 6B would be identical to actions described under Alternative 6A.

Impact SW-1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Effects on SWP and CVP reservoir storage under Alternative 6B would be identical to those described for Impact SW-1 under Alternative 6A because the operations of the facilities would be identical.

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CEQA Conclusion: Effects on SWP and CVP reservoir storage under Alternative 6B would be identical to those described under Alternative 6A because the operations of the facilities would be identical. Therefore, Alternative 6B would result in a less than significant impact on flood management.

Impact SW 2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Effects on surface water flows under Alternative 6B would be identical to those described for Impact SW 2 under Alternative 6A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on surface water flows under Alternative 6B would be identical to those described under Alternative 6A because the operations of the facilities would be identical. Therefore, Alternative 6B would result in less than significant flow impacts on flood management.

Impact SW 3. Substantial increase in reverse flow conditions in Old and Middle Rivers

Effects on Old and Middle River flows under Alternative 6B would be identical to those described for Impact SW 3 under Alternative 6A because the operations of the facilities would be identical.

CEQA Conclusion: Alternative 6B would provide benefits related to reducing reverse flows in Old and Middle Rivers in all months and the impacts would be less than significant.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Impacts associated with construction and operations of facilities under Alternative 6B would be identical to those described under Alternative 1B because the facilities would be identical.

In total, Alternative 6B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 6B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential significant impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

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Impact SW 5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects associated with construction and operations of facilities under Alternative 6B would be identical to those described under Alternative 1B because the facilities would be identical.

Alternative 6B actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 6B would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 6B actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 6B would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility

Effects associated with construction and operations of facilities under Alternative 6B would be identical to those described under Alternative 1B because the facilities would be identical. Alternative 6B would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 6B would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW 6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 6. Implement measures to address potential wind fetch issues

See Mitigation Measure SW 6 in the discussion of Impact SW 6 under Alternative 1A.

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Impact SW 7. Construction of a facility within a 100 year flood hazard area that would impede or redirect flood flows, or be subject inundation by mudflow

Impacts associated with construction and operations of facilities under Alternative 6B would be identical to those described under Alternative 1B because the facilities would be identical. As described under Impact SW 1, Alternative 6B would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW 2. Alternative 6B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 6B would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

6.3.3.13 Alternative 6C—Isolated Conveyance with West Canal and Intakes W1–W5 (15,000 cfs; Operational Scenario D

Facilities construction under Alternative 6C would be identical to those described for Alternative 1C.

Operations of the facilities and implementation of the conservation measures under Alternative 6C would be identical to actions described under Alternative 6A.

Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Effects on SWP and CVP reservoir storage under Alternative 6C would be identical to those described for Impact SW 1 under Alternative 6A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on SWP and CVP reservoir storage under Alternative 6C would be identical to those described under Alternative 6A because the operations of the facilities would be identical. Therefore, Alternative 6C would result in a less than significant impact on flood management.

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Impact SW‑2. Sacramento and San Joaquin River flows in the winter and early spring months of wet years when flood potential is high

Effects on surface water flows under Alternative 6C would be identical to those described for Impact SW‑2 under Alternative 6A because the operations of the facilities would be identical.

CEQA Conclusion: Effects on surface water flows under Alternative 6C would be identical to those described under Alternative 6A because the operations of the facilities would be identical. Therefore, Alternative 6C would result in less than significant river flow impacts on flood management.

Impact SW‑3. Substantial increase in reverse flow conditions in Old and Middle Rivers

Effects on Old and Middle River flows under Alternative 6C would be identical to those described for Impact SW‑3 under Alternative 6A because the operations of the facilities would be identical.

CEQA Conclusion: Alternative 6C would provide benefits related to reducing reverse flows in Old and Middle Rivers in all months and the impacts would be less than significant.

Impact SW‑4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Impacts associated with construction and operations of facilities under Alternative 6C would be identical to those described under Alternative 1C because the facilities would be identical.

In total, Alternative 6C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 6C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential significant impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW‑4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW‑4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW‑4 in the discussion of Impact SW‑4 under Alternative 1A.

Impact SW‑5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Effects associated with construction and operations of facilities under Alternative 6C would be identical to those described under Alternative 1C because the facilities would be identical.

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Alternative 6C actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 6C would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 6C actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 6C would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 5. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

Impact SW 6. Increased exposure of people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of constructed facility.

Impacts associated with construction and operations of facilities under Alternative 6C would be identical to those described under Alternative 1C because the facilities would be identical. Alternative 6B would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 6C would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW 6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 6. Implement measures to address potential wind fetch issues

Wind fetch studies should be completed prior to construction of habitat restoration areas with increased open water in the Delta to determine levee protection methods for adjacent and nearby levees.

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Impact SW 7. Construction of a facility within a 100 year flood hazard area that would impede or redirect flood flows, or be subject to inundation by mudflow.

Effects associated with construction and operations of facilities under Alternative 6C would be identical to those described under Alternative 1C because the facilities would be identical. As described under Impact SW 1, Alternative 6C would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW 2. Alternative 6C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 6C would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

6.3.3.14 Alternative 7—Dual Conveyance with Tunnel, Intakes 2, 3, and 5, and Enhanced Aquatic Conservation (9,000 cfs; Operational Scenario E)

Facilities construction under Alternative 7 would be similar to those described for Alternative 1A with only three intakes.

Operations under Alternative 7 would be similar as under Alternative 1A except for the following actions.

- Alternative 7 would include operations to comply with Fall X2 criteria that will increase Delta outflow in September through November when the previous years were above normal and wet water years, as in the No Action Alternative.
- Alternative 7 would include operations to restrict use of the south Delta exports through specific criteria to reduce reverse flows in Old and Middle River and changes to the south Delta/San Joaquin River flow ratio criteria to a greater extent than Alternative 1A. No diversions at the south Delta intakes would be allowed in April, May, October, and November.
- Alternative 7 would increase Delta outflow from January through August by increasing minimum flows in the Sacramento River at Rio Vista.
- Alternative 7 also would reduce diversions at the north Delta intakes for constant low flow pumping.

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- Due to the restrictions on the use of south Delta intakes, more water would be diverted through the north Delta intakes from December through July in Alternative 7 as compared to Alternative 1A. This operation increases total export patterns in the spring months and decreases total exports in the fall months when north Delta intakes operations would be constrained by north Delta bypass flows, as described in Chapter 3, Description of Alternatives. Delta outflow increases in fall months in above normal and wet years to comply with Fall X2 criteria, but decreases in other months due to increased total exports as compared to No Action Alternative Late Long Term.
- Alternative 7 provides for more frequent spills into Yolo Bypass at Fremont Weir to increase frequency and extent of inundation.

Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Under Alternative 7, reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and No Action Alternative, as shown in Figures 6 10 through 6 13. These differences represent changes under Alternative 7 and changes due to sea level rise and climate change.

Changes due to sea level rise and climate change are indicated through the comparison of or reservoir storage under No Action Alternative Late Long Term as compared to reservoir storage under No Action Alternative. Reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6 10 through 6 13, due to sea level rise and climate change.

Reservoir storages in Shasta Lake, Trinity Lake, and Lake Oroville at the end of May under Alternative 7 would be greater than reservoir storage under No Action Late Long Term, as described in Section 6.4, Cumulative Analysis. Reservoir storage in Folsom Lake at the end of May under Alternative 7 would be less than or no greater than 1% increase than reservoir storage under No Action Late Long Term, as described in Section 6.4, Cumulative Analysis. The effect would be beneficial related to flood management.

***CEQA Conclusion*:** Alternative 7 would increase the ability to store runoff in the spring in the upper Sacramento River watershed, and therefore, could reduce the potential for flooding downstream of the reservoirs. Therefore, Alternative 7 would result in a less than significant impact on flood management.

Impact SW 2. Sacramento and San Joaquin Rivers flow in the winter and early spring months of wet years when flood potential is high.

Sacramento River at Freeport

Under Alternative 7, high monthly flows in the Sacramento River at Freeport in February under would be about 2% higher than flows under existing conditions and 3% higher than flows under No Action Alternative, as shown in Figure 6 14. However, these differences represent changes under Alternative 7 and changes due to sea level rise and climate change.

High monthly flows in wet years in the Sacramento River at Freeport in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown

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in Figure 6 14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport.

High monthly flows in wet years in the Sacramento River at Freeport in February under Alternative 7 would be lower than under No Action Alternative Late Long Term, as shown in Figure 6 14. On a monthly basis, flood potential at these locations would not change under Alternative 7 as compared to No Action Alternative Late Long Term. Therefore, Alternative 7 would result in a beneficial impact on flood management.

San Joaquin River at Vernalis

Under Alternative 7, high monthly flows in the San Joaquin River at Vernalis in March in wet years would be about 9% higher than flows under existing conditions and about 6% higher under No Action Alternative, as shown in Figure 6 16. These differences represent changes under Alternative 7 and changes due to sea level rise and climate change.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under No Action Alternative Late Long Term would be about 6% higher than under No Action Alternative, as shown in Figure 6 14. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternative 7 would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 14. On a monthly basis, flood potential at these locations would not change under Alternative 7 as compared to No Action Alternative Late Long Term. Therefore, Alternative 7 would result in no impact on flood management.

Sacramento River at Locations Upstream of Walnut Grove

Under Alternative 7, high monthly flows in the Sacramento River downstream of the north Delta intakes in February would be less than under existing conditions and No Action Alternative, as shown in Figure 6 18. A portion of the reduction in flows would be due to climate change, especially in April through September when the flows under the No Action Alternative Late Long Term would be less than flows under No Action Alternative. However, flows downstream of the north Delta intakes would be reduced in all months on a long term average due to the operations of the north Delta intakes.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6 18.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternative 7 would be less than flows under No Action Alternative Late Long Term, as shown in Figure 6 18. On a monthly basis, flood potential at these locations would not change under Alternative 7 as compared to No Action Alternative Late Long Term. Therefore, Alternative 7 would result in a beneficial impact on flood management.

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Trinity River Downstream of Lewiston Dam

Under Alternative 7, high monthly flows in Trinity River downstream of Lewiston Lake in May in wet years would be similar to flows under existing conditions and No Action Alternative for, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under No Action Alternative Late Long Term would be similar to flows under No Action Alternative, as shown in Figure 6 20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under Alternative 7 would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 20. On a monthly basis, flood potential at these locations would not change under Alternative 7 as compared to No Action Alternative Late Long Term. Therefore, Alternative 7 would result in no impact on flood management.

American River Downstream of Nimbus Dam

Under Alternative 7, high monthly flows in the American River at Nimbus Dam in January and February in wet years under Alternative 7 would be 20 to 30% higher than flows under existing conditions and No Action Alternative, as shown in Figure 6 22. These differences represent changes under Alternative 7 and changes due to sea level rise and climate change.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under No Action Alternative Late Long Term would be 20 to 30% higher than under No Action Alternative, as shown in Figure 6 22.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under Alternative 7 would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6 22. On a monthly basis, flood potential at these locations would not be adverse under Alternative 7 as compared to No Action Alternative Late Long Term. Therefore, Alternative 7 would result in no impact on flood management.

Feather River Downstream of Thermalito Dam

Under Alternative 7, high monthly flows in wet years in the Feather River at Thermalito Dam in February would be 19% higher than flows under existing conditions and 43% higher than flows under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24. A portion of the changes would be related to climate change.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24 would not exceed channel capacity of 150,000 cfs in this location.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternative 7 would be 11% higher than under No Action Alternative Late Long Term because water is released from Lake Oroville for diversions at the north Delta intakes in the winter months, as described in Chapter 5, Water Supply. However, the average monthly flows in the high monthly flows would not exceed channel capacity of 150,000 cfs in this location. Therefore, Alternative 7 would not result in an adverse impact on flood management.

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Yolo Bypass at Fremont Weir

Under Alternative 7, peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years would be 39% higher than peak monthly spills under existing conditions and 42% higher than spills under No Action Alternative, as shown in Figure 6 26. A portion of the changes would be related to climate change.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 26.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternative 7 would be 11% higher than under No Action Alternative Late Long Term, as shown in Figure 6 26, because Alternative 7 operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass. as compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir. Therefore, Alternative 7 would not result in an adverse impact on flood management.

Overall, Alternative 7 would not result in an increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 7 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 7 would not result in adverse impacts on flood management.

CEQA Conclusion: Alternative 7 would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 7 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 7 would result in a less than significant impact on flood management.

Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would not occur under Alternative 7 because of export restrictions for the south Delta intakes to avoid reverse flow conditions. Therefore, Alternative 7 would result in a beneficial impact.

CEQA Conclusion: Alternative 7 would provide benefits related to reducing reverse flows in Old and Middle Rivers in all months and the impacts would be less than significant.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Impacts associated with construction and operations of facilities under Alternative 7 would be identical those described under Alternative 1A because the facilities would be identical with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 7.

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In total, Alternative 7 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 7 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems.

Impacts associated with construction and operations of facilities under Alternative 7 would be identical those described under Alternative 1A because the facilities would be identical with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A.

Alternative 7 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 7 would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

CEQA Conclusion: Alternative 7 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 7 would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

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Impact SW 6. Increased exposure of people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of constructed facility.

Impacts associated with construction and operations of facilities under Alternative 7 would be identical those described under Alternative 1A because the facilities would be identical with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 7. Therefore, Alternative 3 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion: Alternative 7 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW 6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 6. Implement measures to address potential wind fetch issues

Wind fetch studies should be completed prior to construction of habitat restoration areas with increased open water in the Delta to determine levee protection methods for adjacent and nearby levees.

Impact SW 7. Construction of a facility within a 100 year flood hazard area that would impede or redirect flood flows, or be subject to inundation by mudflow.

Impacts associated with construction and operations of facilities under Alternative 7 would be identical those described under Alternative 1A because the facilities would be identical with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 4. As described under Impact SW 1, Alternative 7 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW 2. Alternative 7 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 7 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased

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flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

6.3.3.15 Alternative 8—Dual Conveyance with Tunnel, Intakes 2, 3, and 5, and Increased Delta Outflow (9,000 cfs; Operational Scenario F)

[*Note to Lead Agencies: description of Alternative 8 environmental consequences and impact analysis is in preparation.*]

6.3.3.16 Alternative 9—Separate Corridors (15,000 cfs; Operational Scenario G)

Facilities constructed under Alternative 9 would include two fish screened intakes along the Sacramento River near Walnut Grove, fourteen operable barriers, two pumping plants and other associated facilities, two culvert siphons, three canal segments, new levees, and new channel connections. Some existing channels would also be enlarged under this alternative. Nearby areas would be altered as work or staging areas or used for the deposition of spoils.

Alternative 9 does not include north Delta intakes. Instead, water continues to flow by gravity from the Sacramento River into two existing channels, Delta Cross Channel and Georgiana Slough. Alternative 9 operates in a manner more similar to No Action Alternative with operational criteria related to minimizing reverse flows in Old and Middle rivers applying only to Middle River and not including San Joaquin River export/inflow ratio criteria.

Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

Under Alternative 9, reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and No Action Alternative, as shown in Figures 6 10 through 6 13. These differences represent changes under Alternative 1A and changes due to sea level rise and climate change.

Changes due to sea level rise and climate change are indicated through the comparison of or reservoir storage under No Action Alternative Late Long Term as compared to reservoir storage under No Action Alternative. Reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6 10 through 6 13, due to sea level rise and climate change.

Reservoir storages in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake at the end of May under Alternative 9 would be equal to or less than reservoir storage under No Action Late Long Term, as described in Section 6.4, Cumulative Analysis. The reduction in reservoir storage at the end of May would occur because Alternative 9 would increase exports during winter and spring months as compared to the No Action Alternative. The reduced storage volumes would allow for storage of

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additional runoff that could reduce the potential for flooding downstream of the reservoirs. The effect would be beneficial related to flood management.

CEQA Conclusion: Alternative 9 would increase the ability to store runoff in the spring in the upper Sacramento River watershed, and therefore, could reduce the potential for flooding downstream of the reservoirs. Therefore, Alternative 9 would result in a less than significant impact on flood management.

Impact SW-2. Sacramento and San Joaquin Rivers flow in the winter and early spring months of wet years when flood potential is high.

Sacramento River at Freeport

Under Alternative 9, high monthly flows in the Sacramento River at Freeport in February under would be about 10% higher than flows under existing conditions and 3% higher than flows under No Action Alternative, as shown in Figure 6-14. However, these differences represent changes under Alternative 9 and changes due to sea level rise and climate change.

High monthly flows in wet years in the Sacramento River at Freeport in February under No Action Alternative Late Long-Term would be about 5% higher than under No Action Alternative, as shown in Figure 6-14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport.

High monthly flows in wet years in the Sacramento River at Freeport in February under Alternative 9 would be lower than under No Action Alternative Late Long-Term, as shown in Figure 6-14. On a monthly basis, flood potential at these locations would not change under Alternative 9 as compared to No Action Alternative Late Long-Term. Therefore, Alternative 9 would result in a beneficial impact on flood management.

San Joaquin River at Vernalis

Under Alternative 9, high monthly flows in the San Joaquin River at Vernalis in March in wet years would be about 5% higher than flows under existing conditions and about 6% higher under No Action Alternative, as shown in Figure 6-16. These differences represent changes under Alternative 9 and changes due to sea level rise and climate change.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under No Action Alternative Late Long-Term would be about 6% higher than under No Action Alternative, as shown in Figure 6-14. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternative 9 would be similar to flows under No Action Alternative Late Long-Term, as shown in Figure 6-14. On a monthly basis, flood potential at these locations would not change under Alternative 9 as compared to No Action Alternative Late Long-Term. Therefore, Alternative 9 would result in no impact on flood management.

Sacramento River at Locations Upstream of Walnut Grove

Under Alternative 9, high monthly flows in the Sacramento River downstream of the north Delta intakes in February would be 2% higher than under existing conditions and 3% higher than No

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Action Alternative, as shown in Figure 6-18. A portion of the reduction in flows would be due to climate change, especially in April through September when the flows under the No Action Alternative Late Long Term would be less than flows under No Action Alternative. However, flows downstream of the north Delta intakes would be reduced in all months on a long-term average due to the operations of the north Delta intakes.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6-18.

High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternative 9 would be less than flows under No Action Alternative Late Long Term, as shown in Figure 6-18. On a monthly basis, flood potential at these locations would not change under Alternative 9 as compared to No Action Alternative Late Long Term. Therefore, Alternative 9 would result in a beneficial impact on flood management.

Trinity River Downstream of Lewiston Dam

Under Alternative 9, high monthly flows in Trinity River downstream of Lewiston Lake in May in wet years would be similar to flows under existing conditions and No Action Alternative for, as shown in Figure 6-20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under No Action Alternative Late Long Term would be similar to flows under No Action Alternative, as shown in Figure 6-20.

High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under Alternative 9 would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6-20. On a monthly basis, flood potential at these locations would not change under Alternative 9 as compared to No Action Alternative Late Long Term. Therefore, Alternative 9 would result in no impact on flood management.

American River Downstream of Nimbus Dam

Under Alternative 9, high monthly flows in the American River at Nimbus Dam in January and February in wet years under Alternative 9 would be 20 to 30% higher than flows under existing conditions and No Action Alternative, as shown in Figure 6-22. These differences represent changes under Alternative 9 and changes due to sea level rise and climate change.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under No Action Alternative Late Long Term would be 20 to 30% higher than under No Action Alternative, as shown in Figure 6-22.

High monthly flows in wet years in the American River at Nimbus Dam in January and February under Alternative 9 would be similar to flows under No Action Alternative Late Long Term, as shown in Figure 6-22. On a monthly basis, flood potential at these locations would not be adverse under Alternative 9 as compared to No Action Alternative Late Long Term. Therefore, Alternative 9 would result in no impact on flood management.

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Feather River Downstream of Thermalito Dam

Under Alternative 9, high monthly flows in wet years in the Feather River at Thermalito Dam in February would be 18% higher than flows under existing conditions and 28% higher than flows under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24. A portion of the changes would be related to climate change.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24 would not exceed channel capacity of 150,000 cfs in this location.

High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternative 9 would be lower than flows under No Action Alternative Late Long Term. Therefore, Alternative 9 would not result in an adverse impact on flood management.

Yolo Bypass at Fremont Weir

Under Alternative 9, peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years would be 31% higher than peak monthly spills under existing conditions and 35% higher than spills under No Action Alternative, as shown in Figure 6 26. A portion of the changes would be related to climate change.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 26.

High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternative 9 would be 5% higher than under No Action Alternative Late Long Term, as shown in Figure 6 26, because Alternative 9 operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass as compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir. Therefore, Alternative 9 would not result in an adverse impact on flood management.

Overall, Alternative 9 would not result in an increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 9 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 9 would not result in adverse impacts on flood management.

CEQA Conclusion: Alternative 9 would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 9 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 9 would result in a less than significant impact on flood management.

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Impact SW 3. Reverse flow conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be less likely under Alternative 9 on a long term average basis except in December, February, April, and May as compared to reverse flows under existing conditions; and except in September, November, December, April, and May as compared to conditions under No Action Alternative, as shown in Figure 6 27. Therefore, Alternative 9 would result in beneficial impacts toward reductions in reverse flow conditions in Old and Middle Rivers in the majority of months with adverse impacts with increased reverse flow conditions in four months under existing conditions and five months under No Action Alternative.

Reverse flow conditions in Old and Middle Rivers would be affected by sea level rise and climate change. Under the No Action Alternative Late Long Term Reverse flow conditions for Old and Middle River flows would be less likely to occur on a long term average basis except in April and May as compared to reverse flows under No Action Alternative, as shown in Figure 6 27.

Reverse flow conditions under Alternative 9 would be less likely to occur on a long term average basis only in June as compared to No Action Alternative Late Long Term.

CEQA Conclusion: Alternative 9 would provide benefits related to reducing reverse flows in Old and Middle Rivers in eight months and adverse impacts in increased reverse flow conditions in four months as compared to existing conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage patterns or substantial increase in the rate or amount of surface runoff

Construction of the facilities under Alternative 9 would involved construction of fish screens, operable barriers, armored levees, and setback levees in the water; dredging; associated facilities on adjacent lands; and habitat restoration in the water.

Construction of the facilities included in Alternative 9 would require excavation, grading, or stockpiling at project facility sites or at temporary work sites. These activities would result in temporary and long term changes to drainage patterns, paths and facilities that would, in turn, cause changes in drainage flow rates, directions and velocities.

Site grading needed to construct any of the proposed facilities has the potential to block, reroute, or temporarily detain and impound surface water in existing drainages, which would result in increases and decreases in flow rates, velocities, and water surface elevations. Changes in drainage depths would vary depending on the specific conditions at each of the temporary work sites. As drainage paths would be blocked by construction activities, the temporary ponding of drainage water could occur and result in decreases in drainage flow rates downstream of the new facilities, increases in water surface elevations, and decreases in velocities upstream of the new facilities. Alternative 9 facilities would temporarily and directly affect existing water bodies and drainage facilities.

Alternative 9 would include installation of temporary drainage bypass facilities, long term cross drainage, and replacement of existing drainage facilities that would be disrupted due to construction of new facilities. These facilities would be constructed prior to disconnecting or crossing existing drainage facilities, as described in Chapter 3, Description of Alternatives.

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Paving, compaction of soil and other activities that would increase land imperviousness could result in decreases in precipitation infiltration into the soil, and could increase drainage runoff flows into receiving drainages.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 3, Description of Alternatives, and Chapter 7, Groundwater), and discharged to local drainage channels or rivers. This would result in a localized increase in flows and water surface elevations in the receiving channels. Dewatering would be a continuous operation initiated one to four weeks prior to excavation and would continue until the excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board.

Construction of facilities within water bodies would include the installation of cofferdams at each location. The cofferdams would impede river flows, resulting in hydraulic impacts. Water surface elevations upstream of the cofferdams could increase under flood flow conditions by approximately 1/2 foot relative to existing conditions and No Action Alternative. Under existing regulations, the USACE, CVFPB, and DWR would require installation of setback levees or other measures to maintain existing flow capacity in the waterways during construction and operations, which would prevent unacceptable increases in river water surface elevations under flood flow conditions.

Construction of project facilities could impact agricultural irrigation delivery and return flow canals, pumps and other drainage facilities in locations where such agricultural facilities would be crossed or disrupted along existing levees. Stockpiled excavated material from dredging operations could impact agricultural irrigation deliveries and return flows. Alternative 9 would include installation of temporary agricultural flow bypass facilities and provision of replacement drainage facilities to avoid interruptions in agricultural irrigation deliveries or return flows. The temporary flow bypass facilities would be installed and connected before existing facilities would be disconnected or otherwise impacted. Replacement drainage facilities would be installed and connected before the end of construction.

Riparian habitat restoration is anticipated to occur primarily in association with the restoration of tidal marsh habitat, channel margin habitat, and inundated floodplains. The restored vegetation has the potential of increasing channel and/or floodplain roughness, which could result in increases in channel water surface elevations, including under flood flow conditions, and in decreased velocities. Modified channel geometries, although expected to be minimal, has the potential to increase or decrease channel velocities and/or channel water surface elevations, including under flood flow conditions. Alternative 9 would include measures to make the habitat restoration projects flood neutral as required by USACE, CVFPB, and DWR in accordance with existing regulatory requirements. Measures to reduce flood potential could include channel dredging to increase channel capacities and decrease channel velocities and/or water surface elevations. Dredging could be required periodically to maintain tidal circulation.

Expansion of seasonally inundated floodplain restoration areas generally would decrease flows in the existing channels under higher flow conditions, resulting in lower channel velocities and water surface elevations. Hydraulic roughness in the inundated floodplain areas could vary based on the land use that would be allowed there, whether riparian vegetation would be allowed to establish,

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farming would be continued, or residual crop biomass would be used to provide cover, hydrodynamic complexity, and organic carbon sources. However, because these inundated areas would provide new flow area relative to existing conditions and No Action Alternative, the overall hydraulic effect in the existing channels would be to lower channel velocities and water surface elevations under high flow conditions.

In total, Alternative 9 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

CEQA Conclusion: In total, Alternative 9 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems

Construction of the facilities under Alternative 9 would contribute runoff from dewater facilities. As described under Impact SW 4, paving, compaction of soil and other activities that would increase land imperviousness would result in decreases in precipitation infiltration into the soil, and thus increase drainage runoff flows into receiving drainages. Drainage studies would be completed to determine the need for onsite stormwater detention storage during construction or operations.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 8, Water Quality), and discharged to local drainage channels or rivers. This could result in a localized increase in flows and water surface elevations in the receiving channels. Dewatering would be a continuous operation initiated one to four weeks prior to excavation and would continue after excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board, USACE, and CVFPB.

Alternative 9 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 9 would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

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***CEQA Conclusion*:** Alternative 9 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternative 9 would include provisions to design the dewatering system in accordance with these to avoid significant impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 5. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

Impact SW 6. Increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of constructed facility.

As described under Impact SW 4, facilities under Alternative 9 would be designed to avoid increased flood potential as compared to existing conditions or No Action Alternative in accordance with the requirements of the USACE, CVFPB, and DWR. As described under Impact SW 1, Alternative 9 would not increase flood potential on the Sacramento River, San Joaquin River, or Yolo Bypass.

Construction of facilities under Alternative 9 that would disturb existing levees would be required by USACE, CVFPB, and DWR to be designed in a manner that would not adversely effect existing flood protection. Facilities construction would include temporary cofferdams, stability analyses, monitoring and slope remediation, as described in Chapter 3, Description of Alternatives. For the slope stability impacts due to excavation of existing levees for installation of fish screens and operable barriers, sheet pile wall installation would minimize the slope stability impacts during construction. Dewatering inside the cofferdams or adjacent to the existing levees would remove waterside slope resistance and lead to slope instability. Slopes would be constructed in accordance with existing engineering standards, as described in Chapter 3, Description of Alternatives.

Some project facilities could require rerouting of access roads and waterways that could be used during times of evacuation or emergency response.

Construction of tidal marsh habitat, channel margin habitat, and inundated floodplains could increase flood potential due to impacts on adjacent levees. The newly flooded areas would have larger wind fetch lengths compared to the existing fetch lengths of the adjacent leveed channels. An increase in fetch length would result in increases in wave height and velocities that reach the existing levees along adjacent islands and floodplains. These potential increases in wave action could also reach the land side of the remaining existing levees around the restoration area.

Alternative 9 would be designed to avoid increased flood potential as compared to existing conditions or No Action Alternative in accordance with the requirements of the USACE, CVFPB, and DWR.

Alternative 9 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

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CEQA Conclusion: Alternative 9 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-6. Implement measures to address potential wind fetch issues

Wind fetch studies should be completed prior to construction of habitat restoration areas with increased open water in the Delta to determine levee protection methods for adjacent and nearby levees.

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject to inundation by mudflow

As described under Impact SW-4, facilities under Alternative 9 would be designed to avoid increased flood potential as compared to existing conditions or No Action Alternative in accordance with the requirements of the USACE, CVFPB, and DWR. As described under Impact SW-1, Alternative 9 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 9 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

CEQA Conclusion: Alternative 9 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW-4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4.

6.3.4 Cumulative Analysis

Assessment Methodology

Surface water resources effects in the Delta Region and in the areas Upstream of the Delta and in Export Service Area would be expected to change as a result of past, present, and reasonably foreseeable future projects, related to changes in potential risks of floods, surface water flows, and drainage and changes in stream courses during construction and operations of new facilities.

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When the effects of the changes in surface water resources under the alternatives are considered in connection with the potential effects of projects listed in Chapter 3, Description of Alternatives, the potential effects range from beneficial to potentially adverse cumulative effects on surface water resources.

The cumulative analysis includes a quantitative analysis of changes due to sea level rise and climate change through the comparison of results from CALSIM II modeling for No Action Alternative Late Long Term as compared to the alternatives, as described in Section 6.3.3. The cumulative analysis also includes a qualitative analysis of the following projects that could effect surface water resources if they were implemented, however, specific operations of these projects and related effects cannot be determined at this time because these projects are not fully defined or analyzed.

- North Delta Flood Control and Ecosystem Restoration Project: Project that will modify certain levees in a portion of the North Delta (near McCormick Williamson Tract) to reduce flood hazards. In addition, an off channel detention basin is planned to be built to improve channel capacity on Staten Island(DWR 2010d). Environmental impact report has been completed and indicates no adverse effects on surrounding surface waters and benefits for local flood management. Project is undergoing further study at this time.
- Dutch Slough Tidal Marsh Restoration Project: Project that will include levee breaches and the restoration of a dendritic tidal channel system on three parcels between Dutch Slough and Contra Costa Canal (DWR 2010e). Environmental impact report has been completed and indicates no adverse effects on surrounding surface waters.
- Los Vaqueros Reservoir Expansion Project: Project that will increase the storage capacity of Los Vaqueros Reservoir and divert additional water from the Delta intake near Rock Slough to fill the additional storage volume (Reclamation and CCWD 2009). First phase is being constructed. The second phase has been evaluated in an environmental impact report/environmental impact statement that indicate no adverse effects on surrounding surface waters.
- Davis Woodland Water Supply Project: Project that will divert water on the Sacramento River upstream of the American River confluence to be conveyed to a new water treatment plant (City of Davis and City of Woodland 2007). An environmental impact report has been completed and indicates no significant adverse effects on surrounding surface waters.
- San Joaquin River Restoration Program: Program that aims at restoring flows to the San Joaquin River from Friant Dam to the confluence of Merced River (Reclamation 2011). A draft environmental impact report has been completed and indicates no significant adverse effects on surrounding surface waters and benefits for local surface water flows. Project is undergoing further study at this time.

All of these projects have completed draft or final environmental documents that analyzed their potential impacts on surface water resources. According to these documents, the impacts on surface water resources would be less than significant or less than significant after mitigation measures would be implemented.

All of these projects would either specifically improve flood management conditions and reduce flood potential, including the North Delta Flood Control and Ecosystem Restoration Project that would expand the floodplain to reduce peak flood flows; divert additional water that could reduce peak flood flows, including Los Vaqueros Reservoir Expansion Project and Davis Woodland Water

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Supply Project; or not substantially modify peak flows in wet years, such as Dutch Slough Tidal Marsh Restoration Project and San Joaquin River Restoration Program.

Impact SW 1. SWP or CVP reservoir storage in May as indicator of the ability to store flood waters in winter and spring

No Action Alternative

Changes due to sea level rise and climate change are indicated through the comparison of or reservoir storage under No Action Alternative Late Long Term as compared to reservoir storage under No Action Alternative. Reservoir storage at the end of May in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake would be less than under existing conditions and the No Action Alternative, as shown in Figures 6 10 through 6 13, due to sea level rise and climate change.

Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, 7, and 9

Reservoir storages in Shasta Lake, Trinity Lake, Lake Oroville, and Folsom Lake at the end of May in wet and above normal water year types under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, 7, and 9 would be equal to or less than reservoir storage under No Action Late Long Term, as shown in Figures 6 10 through 6 13. The reduced storage volumes would allow for storage of additional runoff that could reduce the potential for flooding downstream of the reservoirs. The effect would be beneficial related to flood management.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in a change in SWP and CVP reservoir storage in May based upon information presented in environmental documentation for these projects related to surface water resources.

CEQA Conclusion: Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, 7, and 9 would increase the ability to store runoff in the spring in the upper Sacramento River watershed, and therefore, could reduce the potential for flooding downstream of the reservoirs. Therefore, Alternative 1A, 1B, 1C would result in a less than significant impact on flood management.

Impact SW 2. Sacramento and San Joaquin rivers flows in the winter and early spring months of wet years when flood potential is high.

No Action Alternative

Sacramento River at Freeport. High monthly flows in wet years in the Sacramento River at Freeport in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6 14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport. Therefore, on a monthly basis, flood potential at these locations would not change under No Action Alternative as compared to No Action Alternative Late Long Term.

San Joaquin River at Vernalis. High monthly flows in wet years in the San Joaquin River at Vernalis in March under No Action Alternative Late Long Term would be about 6% higher than under No Action Alternative, as shown in Figure 6 14. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut.

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Sacramento River at Locations Upstream of Walnut Grove. High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under No Action Alternative Late Long Term would be about 5% higher than under No Action Alternative, as shown in Figure 6 18.

Trinity River Downstream of Lewiston Dam. High monthly flows in wet years in Trinity River downstream of Lewiston Lake in May under No Action Alternative Late Long Term would be similar to flows under No Action Alternative, as shown in Figure 6 20.

American River Downstream of Nimbus Dam. High monthly flows in wet years in the American River in January and February under No Action Alternative Late Long Term would be 20 to 30% higher than under No Action Alternative, as shown in Figure 6 22.

Feather River Downstream of Thermalito Dam. High monthly flows in wet years in the Feather River at Thermalito Dam in February under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 24. The peak flows would be shifted from March to February, as shown in Figure 6 24 and would not exceed channel capacity of 150,000 cfs in this location.

Yolo Bypass at Fremont Weir. High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under No Action Alternative Late Long Term would be 28% higher than under No Action Alternative, as shown in Figure 6 26.

Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7

Sacramento River at Freeport. High monthly flows in wet years in the Sacramento River at Freeport in February under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would be similar to or lower than under No Action Alternative Late Long Term, as shown in Figure 6 14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport. Therefore, on a monthly basis, flood potential at these locations would not change under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

San Joaquin River at Vernalis. High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would be similar to or lower than the flows under No Action Alternative Late Long Term, as shown in Figure 6 16. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut. Therefore, on a monthly basis, flood potential at these locations would not change under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

Sacramento River at Locations Upstream of Walnut Grove. High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would be lower than flows under No Action Alternative Late Long Term, as shown in Figure 6 18. On a monthly basis, flood potential at these locations would not change under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

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Trinity River Downstream of Lewiston Dam. High monthly flows in the Trinity River downstream of Lewiston Lake in May under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would be similar to or lower than the flows under No Action Alternative Late Long Term, as shown in Figure 6 20. On a monthly basis, flood potential at these locations would not change under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

American River Downstream of Nimbus Dam. High monthly flows in wet years in the American River in January and February under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would be similar to or lower than flows under No Action Alternative Late Long Term, as shown in Figure 6 22. On a monthly basis, flood potential at these locations would not change under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

Feather River Downstream of Thermalito Dam. High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would be 8 to 18% higher than under No Action Alternative Late Long Term because water is released from Lake Oroville for diversions at the north Delta intakes in the winter months, as described in Chapter 5, Water Supply. However, the average monthly flows in the high monthly flows would not exceed channel capacity of 150,000 cfs in this location. Therefore, Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would result in no impact on flood management.

Yolo Bypass at Fremont Weir. High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would be 5 to 11% higher than under No Action Alternative Late Long Term, as shown in Figure 6 26, because Alternative 1A operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass. as compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir. Therefore, Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would result in no impact on flood management.

Overall, Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would result in no impacts on flood management.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in a change in surface water flows in the locations considered based upon information presented in environmental documentation for these projects related to surface water resources.

CEQA Conclusion: Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternatives 1A, 1B, 1C, 3, 4, 5, 6A, 6B, 6C, and 7 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No

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Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, and 7 would result in a less than significant impact on flood management.

Alternative 9

Sacramento River at Freeport. High monthly flows in wet years in the Sacramento River at Freeport in February under Alternative 9 would be similar to or lower than under No Action Alternative Late Long Term, as shown in Figure 6 14. The flows would be less than the flood levels of 80,000 cfs in the Sacramento River at Freeport. Therefore, on a monthly basis, flood potential at these locations would not change under Alternative 9 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

San Joaquin River at Vernalis. High monthly flows in wet years in the San Joaquin River at Vernalis in March under Alternative 9 would be similar to or lower than the flows under No Action Alternative Late Long Term, as shown in Figure 6 16. The flows would be less than the flood levels of 15,000 cfs in the San Joaquin River at Vernalis when flows are diverted into Paradise Cut. Therefore, on a monthly basis, flood potential at these locations would not change under Alternative 9 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

Sacramento River at Locations Upstream of Walnut Grove. High monthly flows in wet years in the Sacramento River downstream of the north Delta intakes in February under Alternative 9 would be lower than flows under No Action Alternative Late Long Term, as shown in Figure 6 18. On a monthly basis, flood potential at these locations would not change under Alternative 9 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

Trinity River Downstream of Lewiston Dam. High monthly flows in the Trinity River downstream of Lewiston Lake in May under Alternative 9 would be similar to or lower than the flows under No Action Alternative Late Long Term, as shown in Figure 6 20. On a monthly basis, flood potential at these locations would not change under Alternative 9 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

American River Downstream of Nimbus Dam. High monthly flows in wet years in the American River in January and February under Alternative 9 would be similar to or lower than flows under No Action Alternative Late Long Term, as shown in Figure 6 22. On a monthly basis, flood potential at these locations would not change under Alternative 9 as compared to No Action Alternative Late Long Term, and these alternatives would result in no impact on flood management.

Feather River Downstream of Thermalito Dam. High monthly flows in wet years in the Feather River at Thermalito Dam in February under Alternative 9 would be lower than flows under No Action Alternative Late Long Term because water is released from Lake Oroville for diversions at the north Delta intakes in the winter months, as described in Chapter 5, Water Supply. Therefore, Alternative 9 would result in no impact on flood management.

Yolo Bypass at Fremont Weir. High peak monthly spills into the Yolo Bypass at Fremont Weir in February in wet years under Alternative 9 would be 5% higher than under No Action Alternative Late Long Term, as shown in Figure 6 26, because Alternative 1A operations criteria increases spills into the Yolo Bypass to increase the frequency and inundation period of the Yolo Bypass. as

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compared to existing conditions or No Action Alternative. The flows would be less than the Yolo Bypass capacity of 343,000 cfs at Fremont Weir. Therefore, Alternative 9 would result in no impact on flood management.

Overall, Alternative 9 would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 9 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 9 would result in no impacts on flood management.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in a change in surface water flows in the locations considered based upon information presented in environmental documentation for these projects related to surface water resources.

CEQA Conclusion: Alternative 9 would not result in increase in potential risk for flood management as compared to existing conditions and No Action Alternative without the changes due to sea level rise and climate change are eliminated from the analysis. Flows under Alternative 9 in the locations considered in this analysis either were similar to or less than flows that would occur in existing conditions or No Action Alternative without the changes in sea level rise and climate change; or the increase in flows would be less than the flood capacity for the channels at these locations. Therefore, Alternative 9 would result in a less than significant impact on flood management.

Impact SW 3. Reverse flow conditions in Old and Middle Rivers

No Action Alternative

Reverse flow conditions in Old and Middle Rivers would be affected by sea level rise and climate change. Under the No Action Alternative Late Long Term Reverse flow conditions for Old and Middle River flows would be less likely to occur on a long term average basis except in April and May as compared to reverse flows under No Action Alternative, as shown in Figure 6 27.

Alternatives 1A, 1B, and 1C

Reverse flow conditions for Old and Middle River flows would be less likely in most months on a long term average basis under Alternatives 1A, 1B, and 1Ccompared to flows under No Action Alternative Late Long Term, as shown in Figure 6 27, and would be a benefit in these months. Reverse flow conditions would increase in October and April under Alternatives 1A, 1B, and 1C as compared to No Action Alternative Late Long Term and would be an adverse impact in these months.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased reverse flows in Old and Middle River because these projects would not increase diversions over existing conditions and No Action Alternative based upon information presented in environmental documentation for these projects related to surface water resources.

CEQA Conclusion: Alternatives 1A, 1B, and 1C would provide benefits related to reducing reverse flows in Old and Middle Rivers in most months, and adverse impacts in increased reverse flow

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conditions in October and April as compared to No Action Alternative Late Long Term. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Alternatives 2A, 2B, and 2C

Reverse flow conditions for Old and Middle River flows would be less likely in most months on a long term average basis under Alternatives 2A, 2B, and 2C compared to flows under No Action Alternative Late Long Term, as shown in Figure 6 27, and would be a benefit in these months. Reverse flow conditions would increase in April under Alternatives 2A, 2B, and 2C as compared to No Action Alternative Late Long Term and would be an adverse impact in this month.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased reverse flows in Old and Middle River because these projects would not increase diversions over existing conditions and No Action Alternative based upon information presented in environmental documentation for these projects related to surface water resources.

***CEQA Conclusion*:** Alternatives 2A, 2B, and 2C would provide benefits related to reducing reverse flows in Old and Middle Rivers in most months, and adverse impacts in increased reverse flow conditions in April as compared to No Action Alternative Late Long Term. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Alternatives 3 and 4

Reverse flow conditions for Old and Middle River flows would be less likely in most months on a long term average basis under Alternatives 3and 4 compared to flows under No Action Alternative Late Long Term, as shown in Figure 6 27, and would be a benefit in these months. Reverse flow conditions would increase in April and May under Alternatives 3 and 4 as compared to No Action Alternative Late Long Term and would be an adverse impact in these months.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased reverse flows in Old and Middle River because these projects would not increase diversions over existing conditions and No Action Alternative based upon information presented in environmental documentation for these projects related to surface water resources.

***CEQA Conclusion*:** Alternatives 3 and 4 would provide benefits related to reducing reverse flows in Old and Middle Rivers in most months, and adverse impacts in increased reverse flow conditions in April and May as compared to No Action Alternative Late Long Term. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Alternative 5

Reverse flow conditions for Old and Middle River flows would be less likely in most months on a long term average basis under Alternative 5 compared to flows under No Action Alternative Late

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Long Term, as shown in Figure 6 27, and would be a benefit in these months. Reverse flow conditions would increase in April and December under Alternative 5 as compared to No Action Alternative Late Long Term and would be an adverse impact in these months.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased reverse flows in Old and Middle River because these projects would not increase diversions over existing conditions and No Action Alternative based upon information presented in environmental documentation for these projects related to surface water resources.

CEQA Conclusion: Alternative 5 would provide benefits related to reducing reverse flows in Old and Middle Rivers in most months, and adverse impacts in increased reverse flow conditions in April and December as compared to No Action Alternative Late Long Term. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Alternatives 6A, 6B, 6C, and 7

Reverse flow conditions for Old and Middle River flows would be not occur on a long term average basis under Alternatives 6A, 6B, 6C, and 7compared to flows under No Action Alternative Late Long Term, as shown in Figure 6 27; therefore, Alternatives 6A, 6B, 6C, and 7 would result in beneficial impacts.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased reverse flows in Old and Middle River because these projects would not increase diversions over existing conditions and No Action Alternative based upon information presented in environmental documentation for these projects related to surface water resources.

CEQA Conclusion: Alternatives 6A, 6B, 6C, and 7 would provide benefits related to reducing reverse flows in Old and Middle Rivers in all months as compared to No Action Alternative Late Long Term.

Alternative 9

Reverse flow conditions for Old and Middle River flows would be less likely in all months except June on a long term average basis under Alternative 9 compared to flows under No Action Alternative Late Long Term, as shown in Figure 6 27, and would be a benefit in these months. Reverse flow conditions would increase in June under Alternative 9 as compared to No Action Alternative Late Long Term and would be an adverse impact in this month.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased reverse flows in Old and Middle River because these projects would not increase diversions over existing conditions and No Action Alternative based upon information presented in environmental documentation for these projects related to surface water resources.

CEQA Conclusion: Alternative 9 would provide benefits related to reducing reverse flows in Old and Middle Rivers in all months except in June, and adverse impacts in increased reverse flow conditions in June as compared to No Action Alternative Late Long Term. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of

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these effects are described in Chapter 8, Water Quality, and Chapter 11, Fisheries and Aquatic Resources.

Impact SW 4. Substantial alteration of the existing drainage pattern or substantial increase in the rate or amount of surface runoff

Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9

Construction of the facilities under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would involved construction of facilities in the water and extensive facilities on the land, as well as construction of habitat restoration in the water.

Construction of the facilities on the land under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would require excavation, grading, or stockpiling at project facility sites or at temporary work sites. These activities would result in temporary and long term changes to drainage patterns, paths and facilities that would, in turn, cause changes in drainage flow rates, directions and velocities. These changes would be located near the construction sites and would not result in regional changes.

Site grading needed to construct any of the proposed facilities has the potential to block, reroute, or temporarily detain and impound surface water in existing drainages, which would result in increases and decreases in flow rates, velocities, and water surface elevations. Changes in drainage depths would vary depending on the specific conditions at each of the temporary work sites. As drainage paths would be blocked by construction activities, the temporary ponding of drainage water could occur and result in decreases in drainage flow rates downstream of the new facilities, increases in water surface elevations, and decreases in velocities upstream of the new facilities. Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 facilities could temporarily and directly affect existing water bodies and drainage facilities.

These temporary changes in drainage would be minimized, and in some cases avoided, by construction of new or modified drainage facilities, as described in the Chapter 3, Description of Alternatives. Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would include installation of temporary drainage bypass facilities, long term cross drainage, and replacement of existing drainage facilities that would be disrupted due to construction of new facilities. These facilities would be constructed prior to disconnecting or crossing existing drainage facilities. Locations of stockpiles and other temporary construction features would be selected to minimize flow impedance under flood flow conditions.

Paving, compaction of soil and other activities that would increase land imperviousness would result in decreases in precipitation infiltration into the soil, and thus increase drainage runoff flows into receiving drainages.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 3, Description of Alternatives, and Chapter 8, Water Quality), and discharged to local drainage channels or rivers. This would result in a localized increase in flows and water surface elevations in the receiving channels. Dewatering would be a continuous operation initiated one to four weeks prior to excavation and would continue after excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the

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potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board.

Construction of structures in the waterways would occur under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 and could include the installation of cofferdams. The cofferdams would impede river flows, resulting in hydraulic impacts. Water surface elevations upstream of the cofferdams could increase under flood flow conditions by approximately 1/2 foot relative to No Action Alternative Late Long Term conditions. Under existing regulations, the USACE, CVFPB, and DWR would require installation of setback levees or other measures to maintain existing flow capacity in the waterways during construction and operations of any structure located within the water, which would prevent unacceptable increases in river water surface elevations under flood flow conditions, reverse flow areas, areas of high velocities that could resultin scour, and reflection of flood waves towards other levees.

Sediment and debris would accumulate at locations of structures constructed in the water and periodic dredging would occur, as described in Chapter 3, Description of Alternatives.

Construction of facilities could impact agricultural irrigation delivery and return flow canals, pumps and other drainage facilities in locations where such agricultural facilities would be disturbed. Stockpiled excavated or dredged material could impact agricultural irrigation deliveries and return flows. Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would include installation of temporary agricultural flow bypass facilities and provision of replacement drainage facilities to avoid interruptions in agricultural irrigation deliveries or return flows, as described in Chapter 3, Description of Alternatives. The temporary flow bypass facilities would be installed and connected before existing facilities would be disconnected or otherwise impacted. Replacement drainage facilities would be installed and connected before the end of construction of the proposed conveyance facilities.

Riparian habitat restoration is anticipated to occur primarily in association with the restoration of tidal marsh habitat, channel margin habitat, and inundated floodplains. The restored vegetation has the potential of increasing channel and/or floodplain roughness, which could result in increases in channel water surface elevations, including under flood flow conditions, and in decreased velocities. Modified channel geometries could increase or decrease channel velocities and/or channel water surface elevations, including under flood flow conditions. Under existing regulations, the USACE, CVFPB, and DWR would require the habitat restoration projects to be flood neutral. Measures to reduce flood potential could include channel dredging to increase channel capacities and decrease channel velocities and/or water surface elevations.

Expansion of seasonally inundated floodplain restoration areas generally would decrease flows in the existing channels under higher flow conditions, resulting in lower channel velocities and water surface elevations. Hydraulic roughness in the inundated floodplain areas could vary based on the land use that would be allowed there, whether riparian vegetation would be allowed to establish, farming would be continued, or residual crop biomass would be used to provide cover, hydrodynamic complexity, and organic carbon sources. However, because these inundated areas would provide new flow area relative to existing conditions and No Action Alternative, the overall hydraulic effect in the existing channels would be to lower channel velocities and water surface elevations under high flow conditions.

In total, Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for

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increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near structures constructed within the waterways.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased runoff or changed drainages based upon information presented in environmental documentation for these projects related to surface water resources.

CEQA Conclusion: In total, Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, Description of Alternatives. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4. Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4 under Alternative 1A.

Impact SW 5. Creation or contribution of runoff water from a constructed facility that would exceed the capacity of existing or planned stormwater drainage systems.

Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9

Construction of the facilities under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would contribute runoff from dewater facilities. As described under Impact SW 4, paving, compaction of soil and other activities that would increase land imperviousness would result in decreases in precipitation infiltration into the soil, and could increase drainage runoff flows into receiving drainages.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 8, Water Quality), and discharged to local drainage channels or rivers. This would result in a localized increase in flows and water surface elevations in the receiving channels. Dewatering would be a continuous operation initiated one to four weeks prior to excavation and would continue after excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board, USACE, and CVFPB.

Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations

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during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased runoff or changed drainages based upon information presented in environmental documentation for these projects related to surface water resources.

***CEQA Conclusion*:** Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB. Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would include provisions to design the dewatering system in accordance with these to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 5. Creation or contribution of runoff water from a constructed facility which would exceed the capacity of existing or planned stormwater drainage systems.

Please refer to Mitigation Measure SW 4 under Impact SW 4 above.

Impact SW 6. Increased exposure of people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of constructed facility.

Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9

As described under Impact SW 4, facilities under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would be designed to avoid increased flood potential as compared to existing conditions or No Action Alternative in accordance with the requirements of the USACE, CVFPB, and DWR. As described under Impact SW 1, Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would not increase flood potential on the Sacramento River, San Joaquin River, or Yolo Bypass.

Construction of facilities that would disturb existing levees would be required by USACE, CVFPB, and DWR to be designed in a manner that would not adversely effect existing flood protection. Facilities construction would include temporary cofferdams, stability analyses, monitoring and slope remediation, as described in Chapter 3, Description of Alternatives. For the slope stability impacts due to excavation of the existing levee for installation of new structures, sheet pile wall installation would minimize the slope stability impacts during construction. For the slope stability impacts due to excavation of the existing levees without structures, tie back wall installation and dewatering to maintain slope stability and control seepage would minimize the slope stability impacts associated with construction. Dewatering inside the cofferdams or adjacent to the existing levees would remove waterside slope resistance and lead to slope instability. Slopes would be constructed in accordance with existing engineering standards, as described in Chapter 3, Description of Alternatives.

Some project facilities could require rerouting of access roads and waterways that could be used during times of evacuation or emergency response.

Construction of tidal marsh habitat, channel margin habitat, and inundated floodplains could increase flood potential due to impacts on adjacent levees. The newly flooded areas would have

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larger wind fetch lengths compared to the existing fetch lengths of the adjacent leveed channels. An increase in fetch length would result in increases in wave height and velocities that reach the existing levees along adjacent islands and floodplains. These potential increases in wave action could also reach the land-side of the remaining existing levees around the restoration area.

Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would be designed to avoid increased flood potential as compared to existing conditions or No Action Alternative in accordance with the requirements of the USACE, CVFPB, and DWR.

Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. This impact could become more substantial with sea level rise and climate change.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased risk from floods based upon information presented in environmental documentation for these projects related to surface water resources.

CEQA Conclusion: Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would not result in an increase to exposure of people or structures to flooding due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-6 would reduce this potential impact to a less than significant level. This impact could become more substantial with sea level rise and climate change.

Mitigation Measure SW-6. Increased exposure of people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of constructed facility.

Wind fetch studies should be completed prior to construction of habitat restoration areas with increased open water in the Delta to determine levee protection methods for adjacent and nearby levees.

Impact SW-7. Construction of a facility within a 100-year flood hazard area that would impede or redirect flood flows, or be subject inundation by mudflow.

Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9

As described under Impact SW-4, facilities under Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would be designed to avoid increased flood potential as compared to existing conditions or No Action Alternative in accordance with the requirements of the USACE, CVFPB, and DWR. As described under Impact SW-1, Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in

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the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Implementation of other projects listed above to be considered under the cumulative analysis would not be anticipated to result in increased risk from floods or mudflows based upon information presented in environmental documentation for these projects related to surface water resources.

***CEQA Conclusion*:** Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6, 7, and 9 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW 4 would reduce this potential impact to a less than significant level.

Mitigation Measure SW 4 . Implement measures to reduce runoff and sedimentation

See Mitigation Measure SW 4 in the discussion of Impact SW 4.

6.4 References

6.4.1 Printed References

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